U. S. DEPARTMENT OF AGRICULTURE.

OFFICE OF EXPERIMENT STATIONS—BULLETIN NO. 136.

A. C. TRUE, Director.

EXPERIMENTS

ON THE

METABOLISM OF MATTER AND ENERGY IN THE HUMAN BODY

1900-1902.

BY

W. O. ATWATER, Ph. D., and F. G. BENEDICT, Ph. D.,

WITH THE COOPERATION OF

A. P. BRYANT, M. S., R. D. MILNER, Ph. B., AND PAUL MURRILL, Ph. D.

WASHINGTON:

GOVERNMENT PRINTING OFFICE.

1903.

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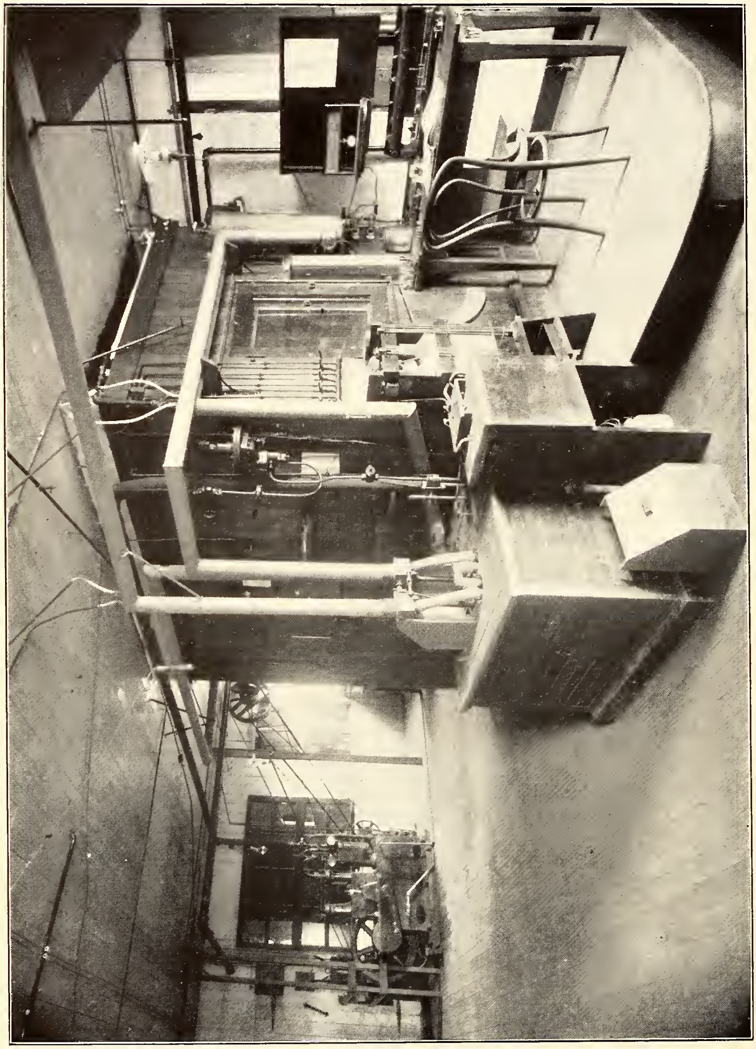

GENERAL VIEW OF RESPIRATION CALORIMETER.

U. S. DEPARTMENT OF AGRICULTURE.

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OFFICE OF EXPERIMENT STATIONS.

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LETTER OF TRANSMITTAL.

U. S. Department of Agriculture,
Office of Experiment Stations,
Washington, D. C., July 1, 1903.

Sir: I have the honor to transmit herewith a report of 21 experiments on the metabolism of matter and energy in the human body, by W. O. Atwater, chief of nutrition investigations, and F. G. Benedict, expert in nutrition investigations, with the cooperation of A. P. Bryant, R. D. Milner, and Paul Murrill.

The experiments here reported form part of a series which is in progress at Middletown, Conn., in cooperation with the Storrs Agricultural Experiment Station and Wesleyan University. They were made with the Atwater-Rosa respiration calorimeter, an account of which, together with the details of the preceding experiments of this series, has been published in earlier bulletins of this Office (Nos. 44, 63, 69, and 109). The present bulletin includes, along with the details of the experiments, an account of a number of important improvements in apparatus and method not hitherto described. The experiments here given, like those previously reported, yield valuable data regarding the conservation and transformations of matter and energy in the body, the demands of the body for nutriment, the effects of muscular work upon such demand, and the actual nutritive values of different food materials and their ingredients.

The results of these experiments are summarized with those of 34 experiments previously reported, making in all 55 experiments, covering one hundred and fifty days, with the subjects in the chamber of the apparatus. From the results of the experiments as a whole, as thus summarized, a considerable number of interesting deductions are drawn.

Such experiments as these have for their ultimate object the study of the fundamental laws of nutrition. The data obtained warrant the conclusion that the respiration calorimeter is an apparatus of precision. The value of the apparatus and the investigations made by means of it is indicated not only by the results obtained, but by the fact that the apparatus and method of inquiry have been very successfully adopted by the Pennsylvania State College Experiment Station

in investigations with animals under the direction of Prof. H. P. Armsby, in cooperation with the Bureau of Animal Industry of this Department, and also by the fact that similar apparatus is already in construction in Europe.

Acknowledgment is here made of the valuable assistance rendered in these investigations by Mr. S. C. Dinsmore, mechanician, who has ingeniously modified and improved several parts of the apparatus and shared in several experiments; by Mr. J. C. Ware, the subject of the experiments, who made various observations within the calorimeter; by Messrs. E. Osterberg and E. N. Swett and Miss C. R. Manning, who made most of the chemical analyses and determinations of heat of combustion of food, etc.; by Messrs. G. W. Hartwell and W. S. Baker, who made a large share of the physical observations during the experiments; by Messrs. W. S. Baker, A. Hansen, J. A. Riche, and K. Oshima, who aided in the chemical work; by Messrs. F. W. Harder, H. E. Bidwell, H. A. Pratt, C. F. Hale, O. C. Becker, and F. N. Freeman, who did a large part of the clerical work of computing and tabulating the results; and by Mr. A. B. Albro, who assisted in preparing the material for publication.

The report is submitted with the recommendation that it be published as Bulletin No. 136 of this Office.

Respectfully,

A. C. True,
Director.

Hon. James Wilson,
Secretary of Agriculture.

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METABOLISM OF MATTER AND ENERGY IN THE HUMAN BODY.

INTRODUCTION.

In the present report will be found the details of 21 experiments upon the metabolism of matter and energy in the human body, made at Middletown, Conn., in the chemical laboratory of Wesleyan University during the years 1900 to 1902, under the auspices of the United States Department of Agriculture in cooperation with the Storrs Experiment Station and Wesleyan University. These experiments are a continuation of those reported in the earlier bulletins of this series,[a] and the same respiration calorimeter and the same general methods of procedure were used as in the earlier work.

The results of the experiments here described in detail are discussed in connection with those of the previous investigations, the especial reason for thus summarizing all the results being found in the fact that they represent all the work which it is planned to carry on of just this nature. The respiration calorimeter with which the experiments were made has undergone an important modification which permits the direct measurement of the amounts of oxygen used by the body, thus making a complete balance of income and outgo of matter and energy possible. And the experiments with the modified apparatus may thus be expected to differ materially from those here and previously described. It is proper, therefore, that the inquiries which were made with the apparatus in its original form and which mark the first phase of the inquiry as a whole should be treated with reasonable completeness before any detailed account is given of the newer apparatus and methods of research.

OBJECT OF THE EXPERIMENTS.

The whole inquiry rests upon the principle that the transformations of matter and energy in the body take place in accordance with the two fundamental laws of the conservation of matter (mass) and the conservation of energy. The object is to get more light upon the ways

[a] U. S. Dept. Agr., Office of Experiment Stations Buls. Nos. 44, 63, 69, 109.

in which these transformations, and especially those of energy, occur. To state the case in another way, the primary object of these experiments is the study of the metabolism of matter and energy in the living organism.

Since nutrition consists largely in the transformations or metabolism of matter and energy, these experiments represent an inquiry into the fundamental laws of nutrition.

Since, furthermore, the main use of food is to supply material and energy for nourishment, this inquiry has to do with the values and uses of foods.

Taken altogether, therefore, we may say that while the more scientific object of the research is a study of the laws of nutrition, in so far as they are laws of metabolism of matter and energy, the practical purpose is to learn more about how the body is nourished and what are the uses and values of food.

QUESTIONS STUDIED.

The principal topics of inquiry in the experiments here reported include the kinds, amounts, and composition of the food used, the digestibility of the nutrients of food and the availability of its energy for use by the body; the kinds and amounts of materials oxidized in the body; the quantity and composition of the excreta eliminated through the different channels; the gains and losses of body substance under different conditions of diet and fasting, work and rest; the amounts of energy transformed under the same conditions; the proof that the law of the conservation of energy obtains in the body; the materials and energy required for the maintenance of the temperature of the body and for internal and external work; the efficiency of the body as a "prime motor," i. e., its capacity to utilize the energy of food and of its own material for muscular work; and, finally, the nutritive values of different classes of nutrients and of foods containing them. Other questions which have received more or less attention are noted in the detailed discussion of the experiments beyond. (Pages 104–201.)

MEN WHO SERVED AS SUBJECTS OF THE EXPERIMENTS.

The experiments were made with young, active men in good health. The purpose thus far has been, and for some time to come will be, the study of the normal nutrition of adults. Later it is hoped that inquiries may be made concerning the normal nutrition of elderly men, children, and others. Should opportunity offer, it seems fair to conclude that important results could be obtained also in studies of nutrition in disease and under the influence of different methods of treatment and other conditions more or less abnormal.

APPARATUS AND METHODS OF INQUIRY.

The respiration calorimeter used in the experiments was devised especially for research of this kind. The apparatus serves to measure the materials received and given off by the body, including the products of respiration, and is thus a "respiration apparatus." It also serves to measure the heat given off by the body and hence is a form of calorimeter. It includes a chamber about 7.5 feet long, 4 feet wide, and 6.5 feet high, so arranged that a man may spend a number of days in comparative comfort within it. It is lighted by a window and is furnished with a folding chair, table, and bed, and when the experiment involves muscular work, with a stationary bicycle also. The chamber is ventilated by a measured current of air, samples of which are taken for analysis before it enters and after it leaves the chamber. In this way the products of respiration are determined. Provision is also made for weighing, sampling, and analyzing all the food and drink, and the solid and liquid excreta as well. By comparing the chemical elements and compounds received by the body in food, drink, and inhaled air with those given off in the solid, liquid, and gaseous forms by the intestines, kidneys, lungs, and skin it is possible to strike a balance between the total income and total outgo of matter in the man's body. This serves as a means of measuring the metabolism of matter in the body.

In addition to this the metabolism of energy is also studied. To this end it is necessary to determine the potential energy of the food and drink taken into the body and of the solid and liquid excreta given off by the body, as well as the amounts of energy given off in the form of heat, external muscular work, and otherwise. The measurements of the potential energy of the food and excreta are made with the bomb calorimeter.[a] The determination of the heat given off from the body is made by certain arrangements in connection with the respiration calorimeter. A current of water passing through a special coil of pipes suspended in the chamber absorbs the heat that is generated within it, and by measuring the quantity of water that passes through the coil and its rise in temperature the amount of heat absorbed may be determined. To this is added the latent heat of the water vaporized within the chamber.

So delicate are the measurements of temperature that the observer sitting outside and recording the changes every two or four minutes immediately detects a rise or fall of even one-hundredth of a degree in the temperature of the inner copper wall of the respiration chamber, or of the air inside the chamber. If the man inside rises to move

[a] For description of the bomb calorimeter see U. S. Dept. Agr., Office of Experiment Stations Bul. 21, pp. 120–126, and Connecticut (Storrs) Station Rpt. 1897, p. 199, and a more elaborate and recent description in Jour. Amer. Chem. Soc., 25 (1903) p. 659.

about, the increase in the heat given off from his body with this muscular work shows itself in a rise of temperature which may be immediately detected.

In the work experiments the subject spends a certain portion of each day in muscular exercise upon an apparatus arranged as an ergometer, by which the amount of muscular work done may be measured. (See page 30.) From the energy of food, drink, solid and liquid excretory products, and body material stored or lost the net income of energy may be computed. The net outgo is measured by the apparatus. By comparing these the balance of income and outgo of energy is found.

The data obtained as explained above, taken in connection with what is known of the physiological processes that go on in the body, give more accurate information, it is believed, than can be otherwise obtained regarding many of the fundamental laws of nutrition.

DESCRIPTION OF APPARATUS AND METHODS.

The apparatus as a whole has been described in detail in a previous bulletin[a] of this series, and only such parts need be discussed here as have been newly introduced or materially altered since that account was published, the present description being regarded chiefly as supplementary to the former.

GENERAL PLAN OF CALORIMETER LABORATORY.

The frontispiece gives a general view of the respiration calorimeter and some of its accessories; and in fig. 1 is shown the ground plan of the laboratory and the disposition of the apparatus as used for the experiments here reported. The large opening at the end of the calorimeter, which serves as a window and door, faces the east, and light is obtained for the inner chamber from the window in the stone masonry directly opposite. A line shaft runs the whole length of the room from west to east, power being supplied by a 5-horsepower electric motor at the west end of the room. A second motor of smaller power stands beside it ready for use in case of a breakdown, the belting and wiring being so arranged that the change from one motor to the other can be made in one minute. A small air compression pump screwed to the floor directly in front of the small motor is belted to the main shaft and furnishes a supply of compressed air which is stored in a 30-gallon water boiler, B, suspended from the ceiling, and is used to actuate the automatic brine pump and the valves of the meter pump. The ammonia refrigerating machine is likewise belted from the main shaft, the feed pipe, F, and return pipe, R, being carried along the ceiling. The brine tank, which is cooled by the ammonia machine, stands at one corner of the calorimeter proper, and

[a] U. S. Dept. Agr., Office of Experiment Stations Bul. 63.

the water cooling tank is so situated that its overflow drains back into the brine tank. The compressed air brine pump is placed in the corner

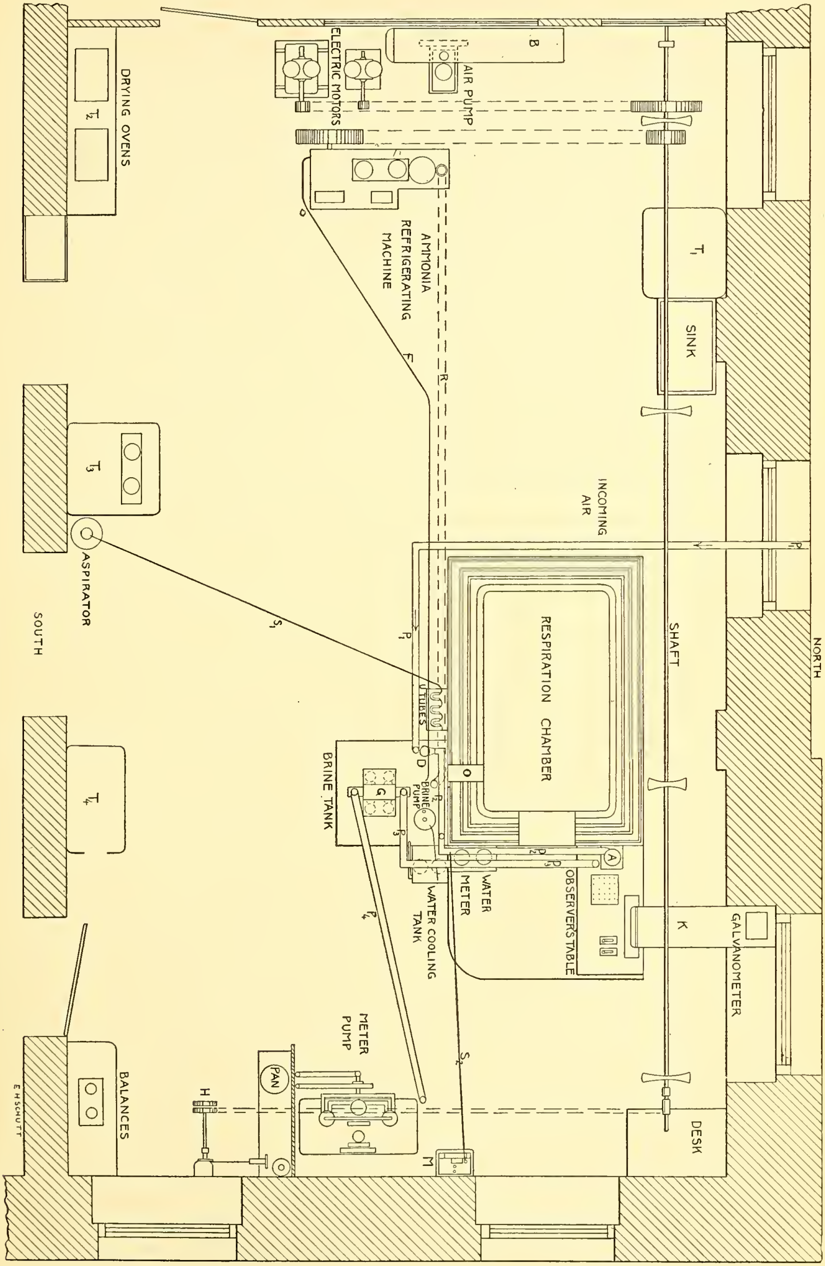

Fig. 1.—Ground plan of respiration calorimeter laboratory.

of the large brine tank. The observer's table, water meter, and air temperature regulating device, A, are placed at the front of the calo-

rimeter, while the food aperture, O, and the arrangements for holding the U tubes used for analyses of residual air are at the side. An aspirator holding approximately 15 liters and used for taking samples of air for analysis is placed on a table at the south side of the room, the air pipe, S_1, being carried along the ceiling.

The air used for ventilating the respiration chamber is drawn through a pipe, P_1, which projects through the window at the rear of the calorimeter, turns the corner of the calorimeter, and enters the incoming freezer, D, in a corner of the freezing tank. It then continues around the calorimeter, entering the chamber after passing through the heat regulating device, A. After coming out of the chamber the air returns by a parallel pipe, P_3, to the outcoming air freezers, G, from which it passes to the meter pump. The pump is placed in the east end of the room and is belted from the main shaft by means of a small counter shaft, H. A wooden partition separates the pans for collecting samples of air for analyses from the meter pump.

The galvanometer is securely fastened to the masonry in one of the windows, and its deflections are conveniently read in a black cloth box, K, by the observer. The balances, drying ovens, sink, tables, T_1, T_2, T_3, T_4, and desk are used for various analytical operations and calculations necessary for the conduct of an experiment. On the wall immediately back of the meter pump is the small air meter, M, used for measuring the samples of incoming air for analyses, the sample being drawn from the pipe, P_2, just before the air enters the chamber and carried through a small pipe, S_2, to the meter.

DEVICE FOR REGULATING THE FLOW OF WATER FROM THE ASPIRATORS.

When the aspirators were used to take samples of the incoming and outgoing air, considerable difficulty was experienced in securing a constant rate of flow with the continually diminishing "head" of water. If the flow was not constant and proportional to the rate of ventilation, discrepancies were found in the determinations of carbon dioxid and water in the air currents. In the earlier experiments the rate of flow of the water from the aspirators was determined every half hour by collecting and measuring the water delivered in one-half minute in a graduated vessel, and, as the level of the water in the aspirator fell, the water outlet was lowered correspondingly. This arrangement was finally replaced by the device shown in fig. 2, which, in principle, is not unlike the "ball and cock" valve of the plumber. As the water flows out of the aspirator it enters the vertical pipe, P, and passes through a longitudinal opening, O, and a small orifice fitted with a tapering plug valve, V. The plug is placed on a lever, to one end of which is fastened a large copper float, F, by a strip of copper, S. The rate of flow of water out of the tank is decided by the

lower stopcock, C, through which it escapes, and this rate of outflow is kept constant by the automatic action of the valve, V, by which the water is held at a constant level, and hence the outflow rate remains uniform despite the change of level of the water in the aspirator.

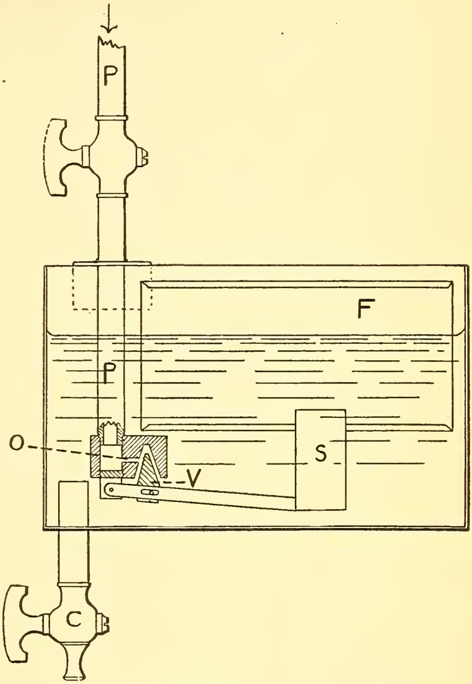

FIG. 2.—Device for regulating flow of water from aspirators.

INCOMING AIR FREEZER.

During the earlier experience with the respiration calorimeter but one incoming air freezer was used, and when it became clogged with frozen ice the air current was stopped, the freezer removed, and the ice melted out by applying hot water, the operation requiring some 20–25 minutes[a] for its completion. For long experiments, especially in damp weather, it was soon found necessary to have a second freezer of similar construction. With this latter the whole operation of stopping the air pump, removing the freezer in use, putting the dry one in its place, and starting the air pump again occupied only thirty to fifty seconds.

VALVE BOX.

The water in the outcoming air current is determined in two portions. The larger portion is condensed and held in two cylindrical freezer cans of copper, which are immersed in the brine tank and weighed at the end of each period. The water not thus condensed is determined in samples after the air current has passed the pump. Two pairs of freezer cans are used. At the end of each experimental period it is necessary to change from one pair to the other. To make the change rapidly and with no admission of room air, a system of valves and openings called the valve box was devised. Obviously all the connections should be substantial and permit of tight closure. Some of the experiments continue ten days, with changes every two hours, making a total of 120 movements of the valve system. To

[a] U. S. Dept. Agr., Office of Experiment Stations Bul. 44, p. 22.

construct a system of valves that would actuate perfectly and without leak during this time was not a simple matter. The earlier form of valve box was closed with rubber stoppers on the end of brass rods running through an opening in the side of the valve box—an arrangement that soon gave evidence of wear and consequent leaks.

The new form shown in fig. 3 was constructed and used in the later experiments. As stated elsewhere (see page 89) it is by no means perfect, though a great improvement over the old form.

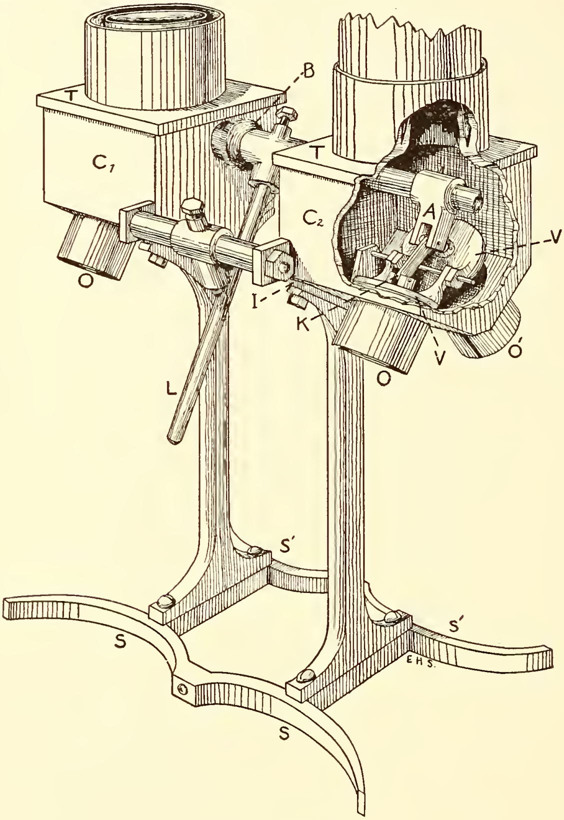

Fig. 3.—Valve box.

Each of the two chambers proper, C_1, C_2, with its two lower openings, O and O′, is cast in one piece, the top, T, being screwed on. The valves, V, are worked on a rocker arm, A, fitted with a stuffing box, B. Knuckle joints, K, insure a firm pressure on the valve seats. By a rapid movement of the long lever, L, the two openings, O and O, on one side of the valve box are closed and the others, O′ and O′, opened. These openings are connected by heavy rubber tubing to the cylindrical freezer cans, which fit against and are clamped to the supports, S, S, and S′, S′.

Despite the insulation, I, between the upright standard and the valve chamber, the temperature of the valve chamber C_1, into which the air entered directly from the calorimeter, was frequently below the dewpoint of the air, and consequently a condensation occurred in this chamber. This was an objection to this form of valve box, for not only was the box subject to the cooling influence of the brine tank to which it was screwed, but the current of air leaving the outcoming air freezers cooled the second chamber, C_2, to such an extent that, in spite of insulation between C_1 and C_2, the former was still further cooled. Moreover, on damp days the whole valve box became covered with moisture, and frequently it collected on the inside of the short pieces of tube to which the rubber tubes leading to the freezer cans were connected, and was afterwards carried into the freezers with the outcoming air. The difficulties with the valve box are here mentioned in detail because they are obviously the cause of discrepancies in the determinations of water in the alcohol check experiments made with this form of apparatus. A further difficulty was encountered in selecting the proper form of packing for the valves. Plans were made for overcoming all these difficulties, but as a fundamental change in the method of determining water in the air current was in contemplation (and has since been adopted) the use of this valve box was continued until the end of the experiments here described.

AUTOMATIC BRINE PUMP.

The water current which passes through the absorber system inside the calorimeter chamber must be previously cooled. The temperature of the cooler used for this purpose is kept down to the proper degree by use of cold calcium chlorid brine from the tank. For conveying this brine to the cooler a hand pump was formerly used; but with the intermittent pumping there was a constant fluctuation in the temperature of the ingoing water. The brine pump shown in fig. 4 was devised to obviate this difficulty. Compressed air is caused to pass through the tube, T. It enters the lower chamber, C, and, acting as in an ordinary wash bottle, forces the cold brine through the long delivery tube, P, into the small tank containing the water coolers. When sufficient brine has been blown out of the can to let the air escape through the long tube, and consequently cause the pressure inside the can to fall, the weight of the float, F, opens a small valve, V, in the top of T and the air rushes through this opening. At the same instant the larger valve, V′, in the bottom of the can opens and brine gradually enters until the float is lifted and the small valve, V, is again closed. At this point the compressed air again forces the brine out through the long tube. The operation is thus continuous. It was found that the tube T, through which the compressed air entered,

became so cold as to freeze any water vapor in the compressed air, and ice thus formed clogged the passage of the air. By passing the compressed air through a series of iron U tubes made by a simple combination of half-inch pipes with return bends immersed in the brine tank, all the water was frozen out and the brine pump acted perfectly. With this pump about a liter of brine at the temperature of −15° C. was forced into the water cooler every two minutes. No noticeable fluctuations in the temperature of the incoming water occurred with this rate of pumping.

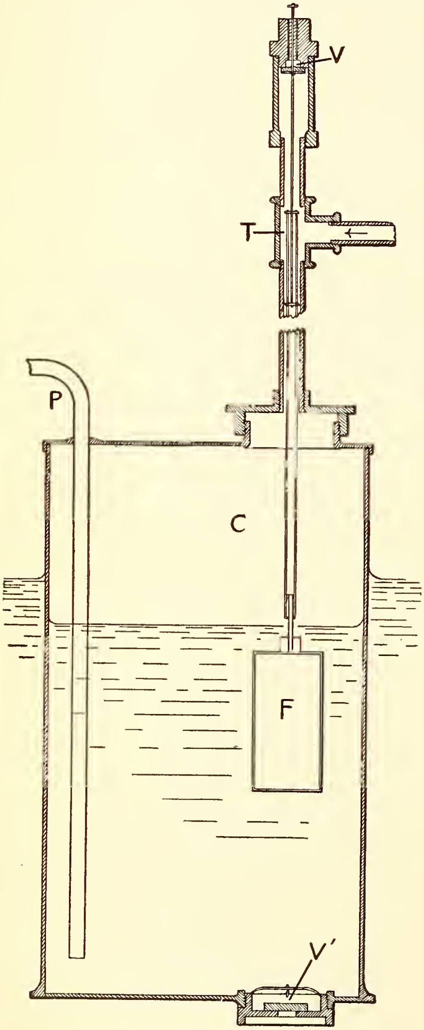

Fig. 4.—Automatic brine pump.

VALVE FOR WATER METER.

The water which passes through the absorber system in the respiration chamber and brings out the heat is measured by a water meter. The use of the siphon in the water meter has proved very satisfactory, since it obviates the necessity of closing the valve after the can has become empty. The earlier form of starting the siphon, i. e., by means of a small hand bulb at the bottom of the meter, proved very unsatisfactory and was the cause of no little annoyance. A much simpler and more satisfactory method for starting the siphon was developed and put in operation by use of a 4-way valve (shown in detail in fig. 5 and as connected with the water meter in fig. 6). The details regarding the construction of the meter have been given before.[a] Two currents of water enter the meter. The water from the respiration chamber, i. e., that to be measured, enters at A and is conducted into either 10-liter can. A second water current enters at B and, flowing through the special valve, is used to start the siphons

[a] U. S. Dept. Agr., Office of Experiment Stations Bul. 63, p. 24.

by which the large cans are emptied. Ordinarily water enters the top of the valve, passes through a pipe out of the central opening at the bottom, and runs into the drain. When the right-hand can is filled to the 10-liter mark the handle of the valve is so turned that the current of water is deflected from the central tube to the right-hand tube from the valve, and this in turn connects with a T tube, T, on the longer end of the siphon, S, from the can. The 10–15 centimeters of water pulling down on this arm suffices to start the siphon, and the handle of the valve is then returned to the original position. The operator simply has to turn the valve and release it when the siphon is started, after which the lead weight, W, which swings as the valve is turned, brings it back to the central point. When the left-hand can is filled the operation is similar, save that the water is deflected into the left-hand opening of the 4-way valve. This valve has been in continuous operation for over a year and has never failed. The amount of water flowing through the central tube is not very large, a small stream sufficing, when deflected, to start the siphon.

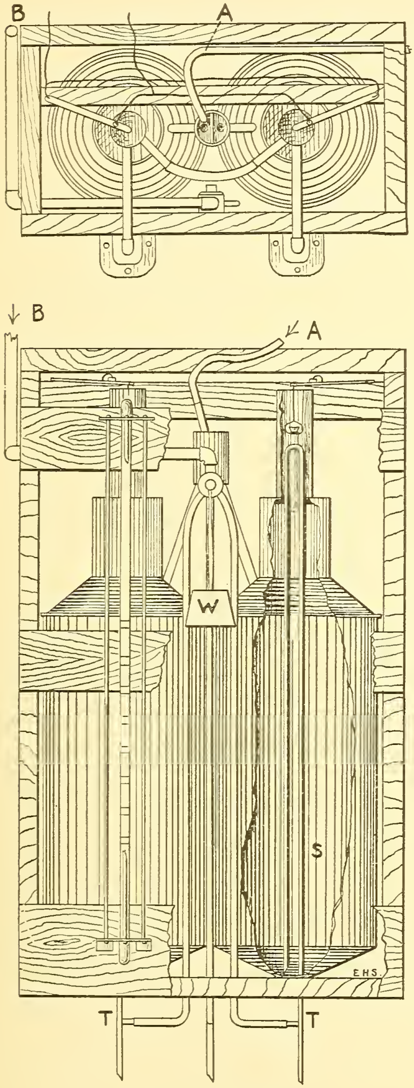

FIG. 6.—Water meter.

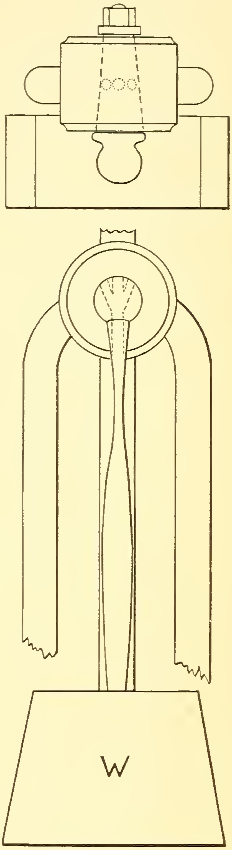

FIG. 5.—Valve for water meter.

THE METER PUMP.

The air pump used in these experiments has been called the Blakeslee pump, from Mr. O. S. Blakeslee, formerly mechanician of Wesleyan University, by whom the larger number of the parts were devised and the whole was very skillfully made. It is based upon a special principle suggested by one of us (W. O. A.), namely, the interplay of

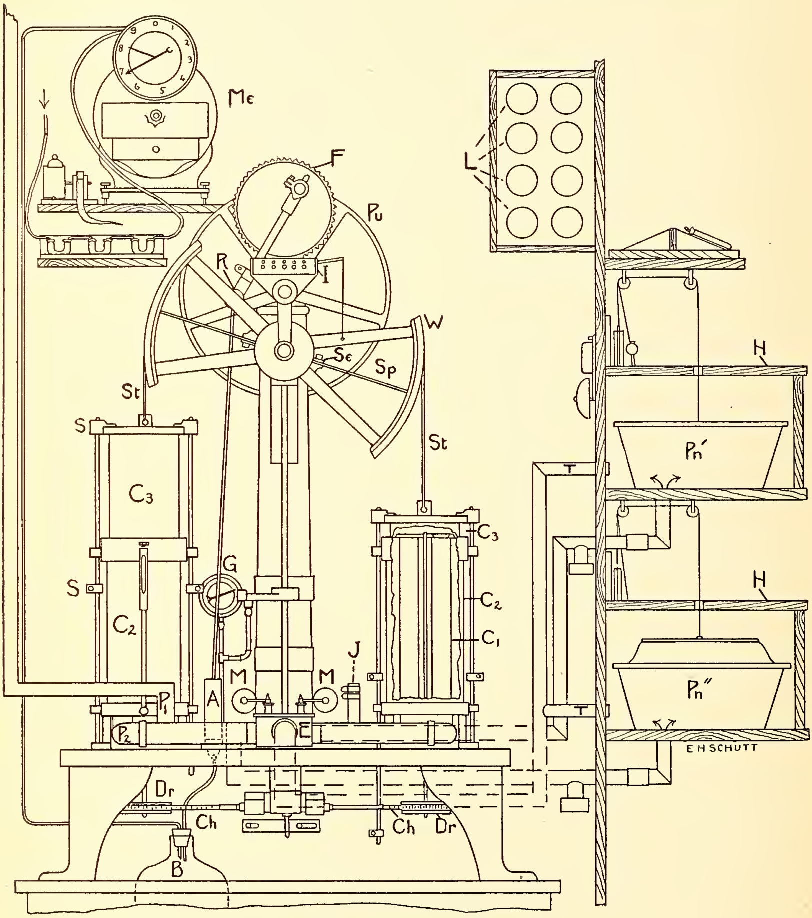

FIG. 7.—Blakeslee meter pump.

steel cylinders, using mercury as a seal. This combination eliminates oil lubrication, which in some experiments might introduce a serious error, and avoids friction, and consequent increase of temperature, which would interfere with accurate measurement of the volume of the air.

The pump was briefly described in a former publication.[a] It was

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[a] U. S. Dept. Agr., Office of Experiment Stations Bul. 63.

expected that a more detailed description with working drawings would be published in a technical journal, but it has been impracticable to prepare such a description, and consequently the following abbreviated technical description is included in this report.

A general view of the pump and connections is shown in fig. 7.[a] There are, in fact, two pumps which work synchronously. Three steel cylinders are used for each pump. The inner and outer cylinders are arranged concentrically, with a narrow annular space between them, which is nearly filled with mercury. Between the inner and outer cylinders, which are stationary, plays a third cylinder, its lower portion being immersed in the mercury. Fig. 8 shows the cylinder system dismantled. The outer and inner cylinders, C^1 and C^2, are fixed, while the movable cylinder, C^3, is fastened to a casting into which two guide rods are fixed. As the movable cylinder rises air enters it through the inlet pipe, P^1, and as the cylinder falls the air passes out through P^2. The air enters and leaves the cylinder through a valve at the top of the inner cylinder, C^1, as shown. The essential feature of this valve is a circular valve plate, V*p*, which is provided with apertures and is made to revolve horizontally, playing upon the ends of P^1 and P^2 so as to close the one while it opens the other, and vice versa. The valve plate, V*p*, is shown with one of the air pipes open. To the left the ingoing, P^1, and outgoing, P^2, air pipes are shown with the couplings by which they are attached to the other parts of the pump. These pipes extend up inside the pump to the top of the stationary cylinders, the ends just reaching through the bottom of the pump proper. The valve is so arranged that when one of these pipes is closed the other is open.

The steel cylinders used in the construction of this pump were mandrel drawn, and consequently very true to size. The inside diameter of the outer cylinder was exactly 6 inches; the outside diameter of the inner cylinder was 5.560 inches, and the steel was 0.0381 inch thick throughout. The length of the stroke of the cylinder is determined by suitable stops, S, and consequently the volume of air delivered at each stroke is constant. By measuring the length of stroke and the diameter of the cylinders, making proper allowance for the changes in level of the mercury as the cylinder was depressed or raised, it was found that with a length of stroke of 229 millimeters each double stroke of the Blakeslee pump delivered 7.7736 liters of air. By varying the length of stroke (by adjusting the position of the stops) or the number of strokes per minute the amount of air drawn through the apparatus could be regulated with great exactness.

The pump is driven by a belt on the large pulley, Pu, shown back

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[a] See also U. S. Dept. Agr., Office of Experiment Stations Bul. 63, Plate VII.

of the walking beam, W, fig. 7, from a countershaft overhead. The speed is reduced by gearing so that the face wheel, F, in front rotates

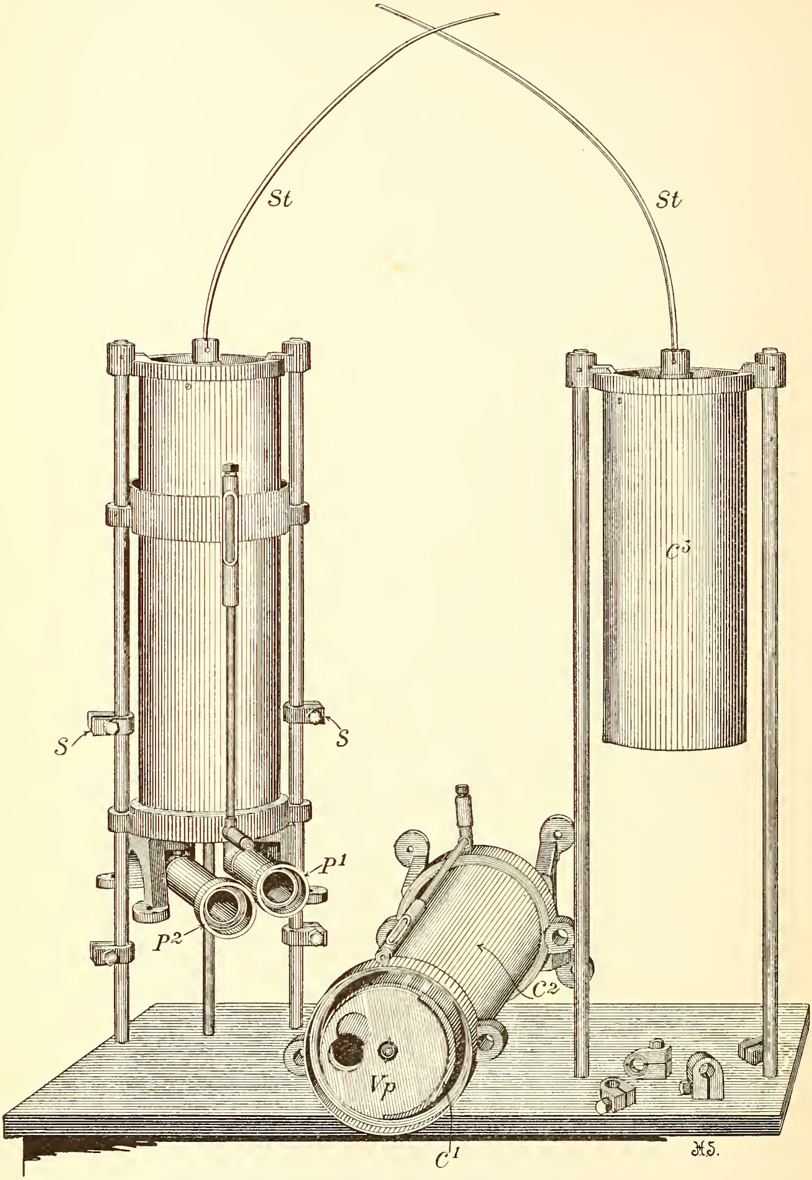

Fig. 8.—Pump cylinder system dismantled.

about ten times a minute, thereby giving a ventilation of not far from 75 liters per minute. On the same shaft with the walking beam is a sleeve, Se, with a projecting arm, which is nearly hidden behind a por-

tion of the walking beam. The end of this arm is attached to the face wheel by a connecting rod, R, as shown in the figure. This conveys an oscillatory motion to the sleeve, which is transmitted to the walking beam by the straight steel springs, Sp, the ends of which are connected at about the middle of the arcs. The cylinders are raised and lowered by means of the steel straps, St, which run over an arc of a circle on the walking beam, whose tangent is always parallel to the guide rods and directly between them, thereby insuring no lateral pressure on the rods and consequently no wearing of parts.

As it was found difficult to actuate the valve, Vp, fig. 8, by mechanical means, since there must be a throw of 10–15 centimeters inside of a fraction of a second, compressed air was used to secure this valve motion. A small air-compression pump was belted to the line shaft in the calorimeter room and compressed air stored in a 30-gallon water boiler suspended from the ceiling of the room. The compressed air was then delivered through a pipe to a smaller air chamber under the Blakeslee pump, which was furnished with a pressure gauge, G, reading to 25 pounds. The compressed air was alternately admitted to the ends of a cylinder with piston, the ends of the piston rod being connected with a sprocket chain, Ch, running around drums, Dr, on the ends of the long axes fastened to the centers of the valve plates. The sprocket chain replaced the steel strap shown in the earlier photographs of this pump.[a] A small turn-buckle provided for any slackening in the sprocket chain by stretching.

In experimenting on the air pressure required to actuate the valves it was found that not less than 7 pounds could be relied upon to cause the long throw of the piston—i. e., some 10–15 centimeters—and consequently an air cushion was placed in each end of the cylinder to diminish the shock due to sudden stoppage of the piston and valve system. The whole mass of metal moved through this space in the fraction of a second is very considerable, and nothing but the best construction will permit of this perfect action. When the pump is in operation the walking beam raises one cylinder of the pump, drawing in air until it comes to a stop, at which point there is a moment's period of rest, during which time the air attains atmospheric tension. The next instant the valve is thrown, closing the inlet pipe, P_1, and opening the outlet, P_2. When the cylinder descends the air is expelled, and at the lowest point of the stroke a similar period of rest occurs, during which time the valve is again thrown. To secure this rest period the walking beam raising and lowering the cylinder is provided with a stiff steel spring, Sp, which permits the shaft to turn a fraction of an inch, even after the cylinders have come to rest by virtue of the stop on the upright guide rods. This last movement is

[a] See U. S. Dept. Agr., Office of Experiment Stations Bul. 63, Plate VII.

sufficient to open a port in the compressed-air cylinder; the air escapes into a cylinder similar to one on a steam engine; the piston makes one stroke, which reverses the valves in both pumps, setting one so that air may be drawn in from the ingoing pipe and the other so that the air may be expelled into the exit pipe. All this is done while the cylinders are at rest, and thus the air within them is at atmospheric pressure.

The valve plates, Vp, fig. 8, were ground very true to cover the ends of the two upright tubes through which the air entered and left the middle movable cylinder. It was found necessary, however, to insure perfect closure of this valve, to apply a drop or two of sperm oil to the face of the valve plate.

The volume of each cylinder is known from its dimensions, and an automatic counter, I, records the number of strokes.

A mechanism was added which permits the collection of every fiftieth stroke of the pump for analysis. This is done automatically, and consequently insures fair sampling. The samples are delivered into two tin pans, Pn, fig. 7, with rubber diaphragms, each capable of holding when completely full about 20 liters. At the rate at which the pump is run samples are taken approximately every ten minutes. By means of a small suction pump these samples are continuously withdrawn from the pans through U tubes containing the proper absorbents for water and carbon dioxid.

In front of the base of the standard, fig. 7, are seen the electromagnets, M, used in taking the samples for analysis. Below them is the chamber, E, through which all of the air from the exit pipe must pass before it can escape. There are three openings from this chamber—one in front and one at either side. From the side openings are pipes leading to the receptacles, P, for holding the samples before analysis, termed briefly "pans."

The aliquoting device consists of a series of three valves attached to the outlet pipe from the pump. The air of 49 strokes out of every 50 is discharged into the room, the fiftieth stroke being taken for analysis. The samples for analysis are conveyed to the pans by the following mechanism:

Between the electromagnets and the standard is a ratchet wheel having 100 teeth. At each stroke of the pump this wheel is advanced by one tooth. On the fiftieth stroke a projection on this wheel closes an electric contact, which remains closed during the time occupied by a double stroke (both cylinders full) of the pump. This electric contact serves the dual purpose of closing the outlet valve and opening a valve into a pipe leading to one of the sample-receiving pans, Pn′. This valve motion is produced by the electromagnet, M. At the end of the stroke the circuit is broken and the valve system resumes its original position, and the air continues to flow through the opening in

front. At the one-hundredth stroke a similar projection on the toothed wheel, which, however, is a little lower than and obviously opposite the first one, closes a second electric circuit, which, operating in a similar manner, throws one complete sample of air into the second sample pan, Pn''.

At the rate at which the pump is run a sample of air comes into each pan about every ten minutes, or into alternate pans every five minutes. It was assumed that no considerable change in composition of the air inside the chamber would be effected in the period of five minutes between samples. As a matter of fact, experience showed that, especially at the end of a work period, the pan having the last sample taken nearest the time when the man stopped work always showed a higher percentage of carbon dioxid than the other pan. This point is especially interesting as showing the one main defect in this method of sampling. Theoretically, the amount of carbon dioxid and water collected in both pans should be alike, and the two pans consequently should serve as duplicate analyses. Practically, however, during work experiments they seldom were absolutely alike, while during rest experiments, or alcohol check experiments, when the carbon dioxid evolution was constant, the duplicates agreed very closely.

In the earlier tests made with this pump great difficulty was experienced from the fact that the amount of water found by this method of sampling was invariably higher than that found by the aspirator method. This discrepancy was found to be due to an absorption and passage of water through the rubber diaphragms used to contain the sample of air. A wooden house, H, was made to cover each pan, and the 98 volumes of air not used for analysis, instead of being thrown into the room, were conducted through a tin pipe, T, into these houses over the surface of the rubber, consequently producing equilibrium in moisture content on the inside and outside of the rubber diaphragm. This modification gave good results for the determination of water. No diffusion of carbon dioxid through the diaphragm was ever observed.

The electrical current used for the magnets, M, was obtained from a 220-volt circuit passed through a series parallel arrangement of four couples of 32-candlepower lamps, L. In case the electro-magnet failed to work, the lamps would not be lighted, and consequently the attention of the observers would be drawn. It was found that the large current required to operate this magnet was such as to form an arc, and consequently a blast of air from the compressed-air pipe was constantly blown between the platinum contact points.

SAFETY TRAP FOR AIR PIPES.

The stoppage of the air current between the calorimeter chamber and the Blakeslee pump, while not likely to occur, would have so serious an effect on the pump that it was deemed desirable to insert a trap of the form shown in fig. 9. This consists of an iron cup with four projections fitting the narrowed end of the air pipe, the cup being partly filled with mercury. The depth of the mercury was such that if any considerable tension occurred inside the pipe, air would be drawn from the room, and the peculiar bubbling sound of the air through the mercury would attract the attention of the observers. In our experience this has never occurred on the incoming air pipe, i. e., the pipe going from the freezer box to the pump. Similar traps were placed on the pipes leading from the aliquoting

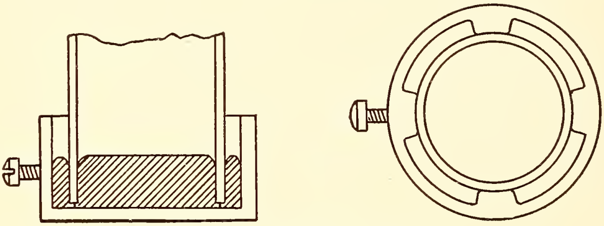

FIG. 9.—Safety trap for air pipes.

device to the pans, so that in case the pans became too full, the air would escape through the mercury trap. This never happened during an experiment, but in preliminary tests this safety device was often found extremely useful.

ANALYSIS OF AIR FROM PANS.

The air sample pans receive about $7\frac{1}{2}$ liters of air every ten minutes and must be emptied at such a rate that this amount of air will be withdrawn before the next sample is received. By means of a suction pump placed near the ceiling, and of a similar pattern to that used for the analysis of the incoming air (see page 29), a partial vacuum is constantly maintained in a large bottle, not shown in the diagram, from which rubber tubes lead to the U tubes through which the air samples are drawn for determination of water and carbon dioxid, as shown in fig. 10. Of the four tubes, the first (counting from the left) contains pumice stone drenched with sulphuric acid to absorb water, the second and third contain soda lime for the absorption of carbon dioxid, and the fourth pumice stone and sulphuric acid to retain the moisture coming from the soda lime.

If the air is withdrawn too rapidly—i. e., faster than the air sam-

ples are delivered—the rubber diaphragms will be drawn close to the pans. If this is allowed to occur, the suction may be so great as to prevent the opening of the valve in the aliquoting device by the electro-magnet. If, on the other hand, the samples are not withdrawn with sufficient degree of rapidity, the air will accumulate in the pans, the rubber diaphragms will be inflated, and there will come a time when there will not be room enough to take a whole sample, and consequently the air will not be forced out of the steel cylinders of the meter pump. As the cylinders fall of their own weight, a slight pressure will serve

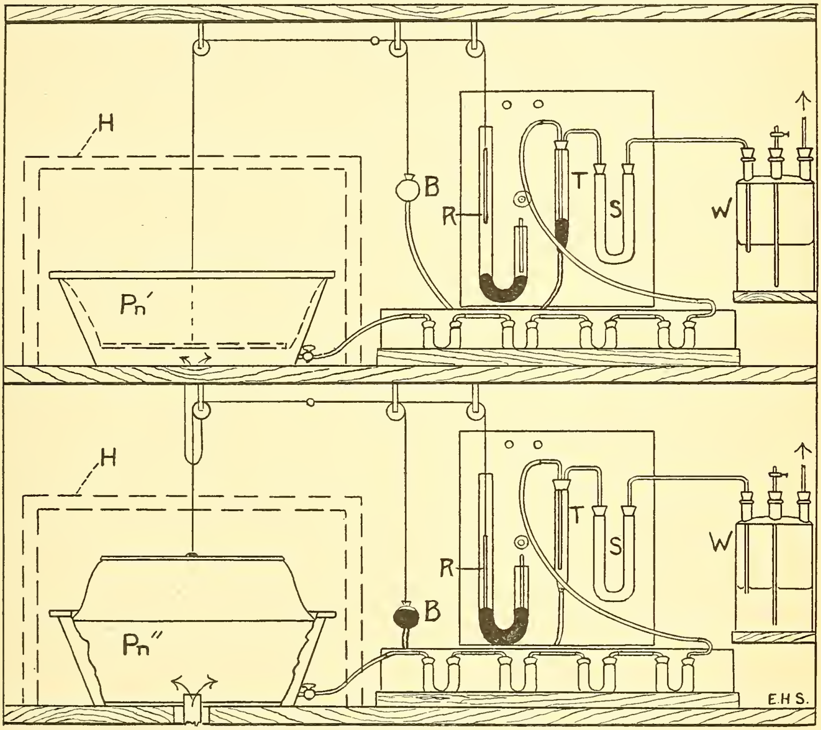

FIG. 10.—Device for collecting and analyzing air sample.

to hold them in the air, and serious results might follow if the walking beam should in its descent strike the suspended cylinder. A device was introduced whereby the amount of air drawn out of the pans could be regulated and accidents prevented. The rate of suction from the U tubes was so arranged that it never was less than 7½ liters every ten minutes and generally exceeded this; consequently the danger of the pans filling was minimized. To prevent the pans becoming exhausted a mercury trap, T, shown in fig. 10, was used. The air leaving the pans, Pn′. Pn″, enters the U tubes which lie on an inclined support and

are thus foreshortened in the figure. The trap tube, T, has a doubly perforated rubber stopper at the top and is drawn out at the bottom. Through the perforations in the stopper pass two smaller glass tubes with elbows, the one at the left being connected by one end to the last of the U tubes by a rubber tube, while the other end reaches nearly to the bottom of T. The air current passes through T, and an empty U tube, S, into the Woulff bottle, W, and thence to the small suction pump. A rubber tube attached to the constricted portion of T connects the latter with a mercury bulb, B. This bulb is attached by silk thread and a pulley system to the rubber diaphragm on the pan. As the diaphragm descends the bulb is raised, the mercury flows into the lower part of T, and at a certain point it covers the end of the inner tube and stops the air current. As the air flows in from the meter pump, the pan fills, the diaphragm rises, the bulb falls, the mercury seal is opened, and free passage for the air is again established. The Woulff bottles, which are partly filled with water through which the air current bubbles, show the rate of passage of the air by the rate of bubbling and serve as a pressure regulator by admitting air from the room when the mercury cuts off the supply of air from the U tubes. By adjusting the pinchcock on the glass tube which passes through the middle neck of the Woulff bottle the flow of the air current is so regulated as to require little attention. As a matter of fact, the small air pump is run at a speed to require more air than is furnished by the samples, and consequently more or less air constantly passes through the central tube in the Woulff bottle.

To insure against accident whereby a pan might be so filled as to be unable to receive an aliquot sample of air (7½ liters) from the meter pump, an alarm system was introduced. Two electrical contacts, J, fig. 7, not unlike those of the aliquot system of the meter pump, but using a much smaller current, are fastened to the air pipe of the pump at such a point that at about twenty-five strokes before the sample is to be delivered to the pan the projection on the toothed wheel closes one of these contacts. If the rubber diaphragm is above a certain point—i. e., that showing a capacity of the pan to receive 7½ additional liters of air—a large signal gong rings. If the diaphragm is below this point the connection is not made. To the diaphragm is fastened a silk cord running over a pulley on the end of which is an iron rod, R, fig. 10. This iron rod by being lowered into mercury in one arm of a U tube raises the level of the mercury so as to close the electric circuit, the final closure being made by the projection on the toothed wheel. If, then, both contacts are made, the signal bell rings. This simple device frequently saved considerable trouble, if, indeed, it did not prevent accident to the apparatus.

ANALYSIS OF AIR ENTERING THE CALORIMETER.

The analysis of the incoming air is effected by drawing a sample slowly through U tubes containing the proper absorbents and then through a 10-liter Elster meter, Me, fig. 7. The sample is taken just after the air leaves the incoming air freezer or just before it enters the respiration calorimeter chamber. A small single-action pump, A, fig. 7, is fastened to the bedplate of the Blakeslee pump and connected with a long rod to the rocker arm of the sleeve, Se. This pump makes a partial vacuum in an 8-liter bottle, B, placed on the floor, which, in turn, is connected with the Elster meter. By means of a pet cock in a T tube the rate of flow of air through the Elster meter can be regulated as desired. The relative arrangements of the meter, U tubes, and small suction pump are shown in fig. 7, and in fig. 1 is shown the connection of the meter, M, with the pipe for the ingoing air, P_2, by means of the small pipe, S_2. The course of the air current is such that after leaving the main air pipe it is drawn first through the three U tubes containing sulphuric acid and soda lime, where it is freed from carbon dioxid and water. From the meter the air passes to the bottle, B, from which it is taken by the pump and delivered into the room.

RECORDING APPARATUS FOR THE AIR METER.

The Elster meter used to determine the volume of the sample of the incoming air records 10 liters and repeats. Since from 160 to 220 liters are taken during each six-hour period, it is necessary to have some arrangement for counting the number of times the meter records 10 liters. For this purpose the simple electrical device shown in detail in fig. 11, and in its general relation to the whole system in fig. 7, was constructed by our mechanician, Mr. S. C. Dinsmore. On the Elster meter the shorter hand in passing the 10-liter mark closes an electric circuit which is arranged in series with one of the magnets on the registering device. When the circuit is closed the armature, A, is drawn down and a pin point makes a hole in the paper tape which travels over the roller back of the clockwork. The axis of the minute hand on the clock is extended for several inches and carries a wooden roll which is covered with rubber and upon which rests a metal roll held between two slotted grooves. The paper tape travels between these two rolls, being moved along as the clock runs. At the end of a six-hour period the air sample is cut off when the 10-liter mark on the meter is reached, and the number of holes punched in the tape multiplied by 10 gives the number of liters used as a sample. A second pair of magnets and armature, A_1, was formerly used to mark on the other edge of the tape the beginning and end of a run by punching a hole

in it when the circuit was closed by a press button. Inasmuch as the number of liters was counted and recorded at the end of each run on the tape torn off, this was not used in later experiments.

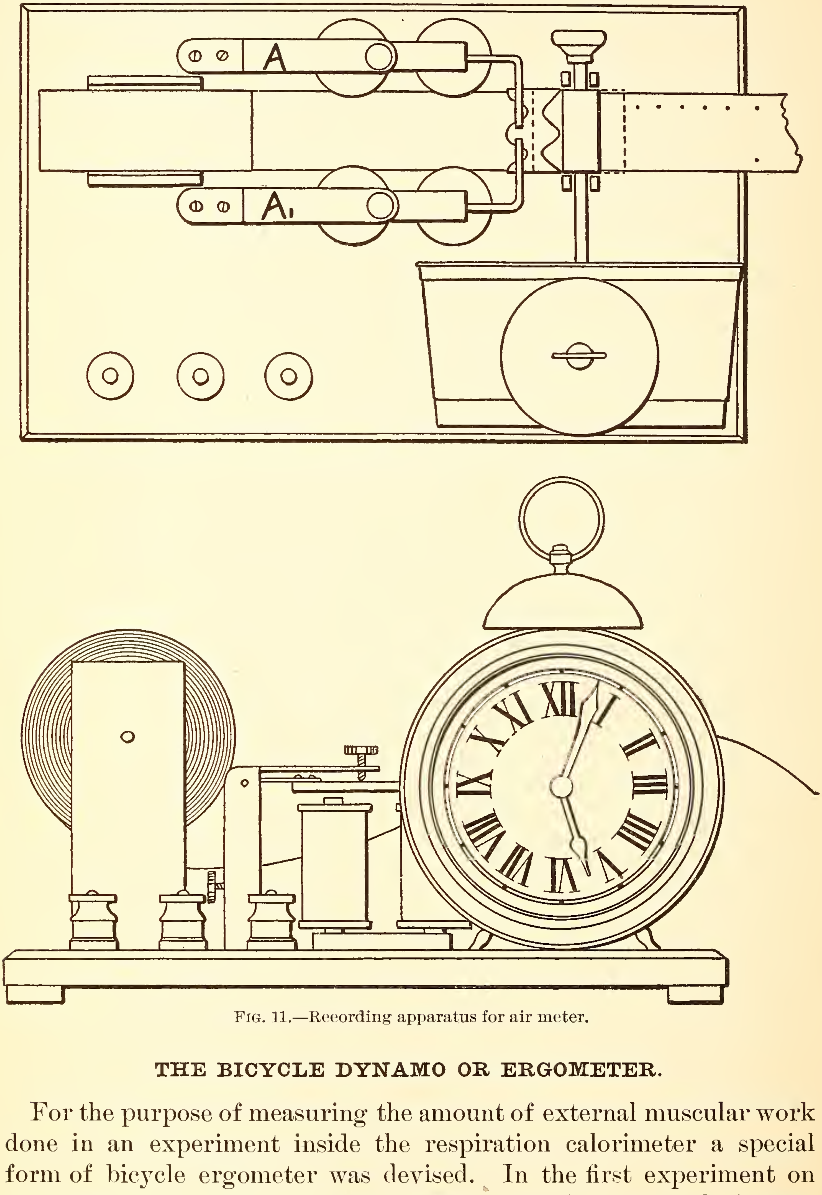

FIG. 11.—Recording apparatus for air meter.

THE BICYCLE DYNAMO OR ERGOMETER.

For the purpose of measuring the amount of external muscular work done in an experiment inside the respiration calorimeter a special form of bicycle ergometer was devised. In the first experiment on muscular work, namely, No. 4 C,[a] a rather primitive method of measuring the work done was followed, consisting of raising and lowering

[a] U. S. Dept. Agr., Office of Experiment Stations Bul. 44, p. 51.

a block of iron weighing 5.7 kilograms by means of a cord and pulley. This arrangement for measuring muscular work was unsatisfactory owing to the introduction of the error of negative work when the weight was lowered, and to the fact that the muscles required for the exercise were not those commonly accustomed to do large amounts of work. This work experiment continued for three days, during which the work was done for eight hours per day.

The fact that large amounts of muscular work can be done with the legs and the high degree of efficiency and muscular training of the bicyclist suggested the use of the bicycle as a means for measuring muscular energy. Consequently a bicycle arrangement was installed

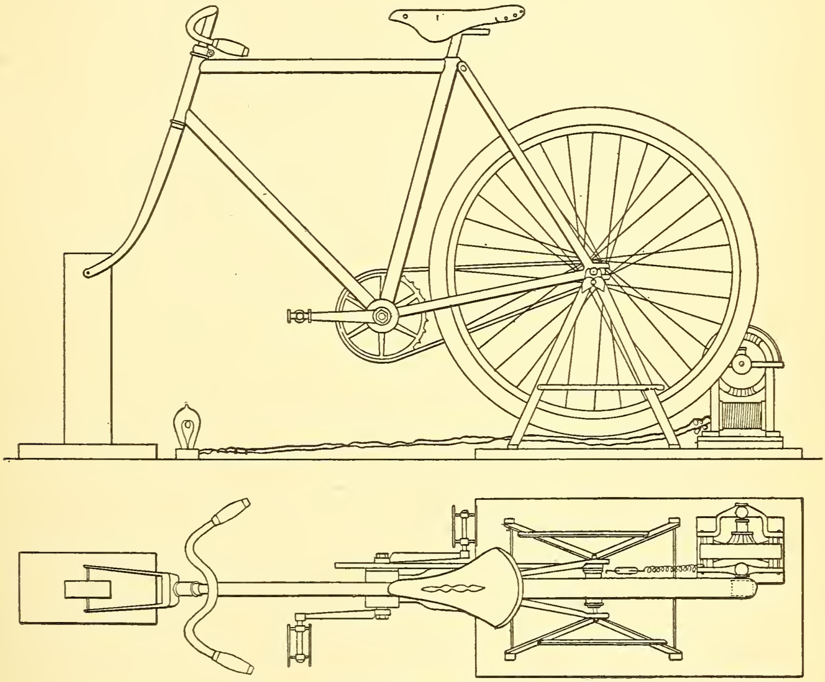

FIG. 12.—Bicycle dynamo or ergometer.

whereby the amount of external muscular work could be measured much more accurately than that done by raising and lowering a weight. The apparatus consisted of an ordinary bicycle, the front wheel of which was replaced by stationary framework, and the rear wheel was so supported in an iron rack or frame that it could be connected with a small dynamo. The earliest form of bicycle ergometer had a solid rubber tire in which a groove was cut and the connection with the dynamo made by means of a belt. This arrangement was found impracticable because, in spite of constant care, the belt would keep coming off and the subject was compelled to stop working and replace it. Later the apparatus was rearranged essentially as is shown

in fig. 12. In this arrangement the pneumatic rubber tire of the bicycle pressed directly against a small pulley on the armature shaft of the dynamo, or, more properly, the pulley was pressed against the bicycle tire. By passing a current through the field of the dynamo a certain degree of resistance could be obtained and sufficient current generated to light a lamp. The friction of the wooden pulley on the rubber tire wore the latter away so rapidly that it was found necessary to protect the rubber tire with a covering of heavy canvas, a strip about 2 centimeters wide being tightly cemented to the rubber tire by means of a belt cement. A similar piece of canvas was attached to the wooden pulley. It was found that this combination protected both the pulley and the tire from wear, and at the same time gave the desired friction. The tire was blown up at the beginning of an experiment, and as extra good valves were used the inflation was not materially diminished at the close of the experiment. To allow for irregularities or inequalities of the tire the dynamo was mounted on a rocking base and the necessary tension was secured by a turn-buckle and a coiled spring which kept the pulley of the dynamo pressed against the tire of the bicycle. The apparatus as thus arranged was used in experiment No. 29 and in all subsequent work experiments.

In this form of bicycle ergometer the energy applied to the pedals is converted into heat, partly by the friction in the pedals and working parts of the apparatus, but mostly by being transformed first into electrical energy and then into heat either in the armature of the dynamo or in the lamp. Consequently a measure of the electrical energy passing through the lamp represents only a part—the larger part, to be sure—of the energy actually transformed into external muscular work. To obtain appropriate data on this point and to calibrate the machine two different methods were used. In the first the apparatus connected ready for use, with a known current through the field, which was separately magnetized, was coupled directly by means of a shaft with a flexible coupling to a one-half horsepower motor, which was run by an electric current from a storage battery. The speed at which the bicycle ergometer was run was determined by counting the number of revolutions of the pedals and also by a speed indicator showing the revolutions of the armature shaft. In the earlier calibrations there was quite a discrepancy between these two observations, due to the fact that either the pulley or the tire slipped somewhat; but later when the canvas was applied to both surfaces and the slipping was overcome, only the revolutions of the pedals were taken, as the pressure of the speed indicator on the armature shaft introduced an undesirable error. The half horsepower motor was run at different speeds with no load, the current and voltage being measured accurately, and the resistance of the armature after it had run for some time being carefully measured to allow for the heating effect in the armature. The actual number of watts required to run

the motor with no load was thus determined for different rates of speed. After coupling with the bicycle ergometer a similar series of observations was made giving the energy required to run the whole system. Deducting the energy required to run the motor with no load gave the energy required to drive the bicycle dynamo.

For each rate of speed a certain voltage on the lamp was observed and in actual experiments instead of recording the speed the observer recorded the voltage on the lamp every four minutes. By means of this data and the curve obtained in the calibration the amount of external mechanical work done could be calculated. The details of the electrical connections for this method of calibrating the apparatus are shown in fig. 13.

A second method of calibration consisted in running the bicycle ergometer itself as a motor and measuring the amount of electricity required to run the system at different speeds. Obviously the lamp could not be used in this test, and consequently to the values obtained by this method of calibration must be added the amount of electrical

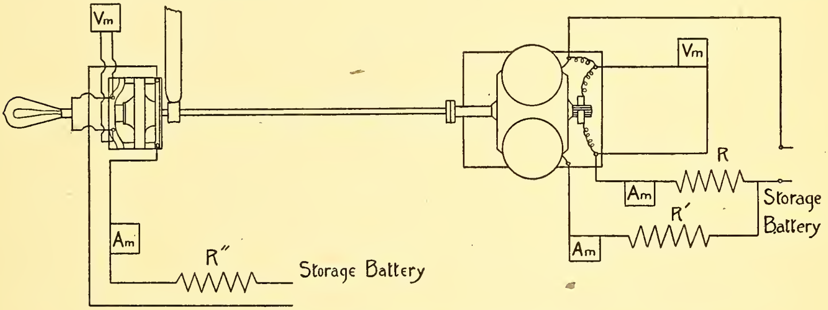

FIG. 13.—Electrical connections for first method of calibrating bicycle ergometer.

energy converted into heat in a lamp when the apparatus is used as an ergometer. Fig. 14 shows the details of the electrical connections. The fields are magnetized with a constant current from the storage battery, and the armature supplied with a constant current from a similar source. By counting the revolutions of the pedals and making the proper corrections for the heating effect in the armature the total energy required to run the system without the lamp could be very accurately determined. As before, the voltage on the lamp gave the rate of speed and consequently the necessary data for use with the curve obtained by the calibration to determine the amount of external muscular work done. Calibrations by these two methods agreed very closely, and as the second was much simpler to carry out than the first it was invariably used in the later work.

Owing to the chance for varying resistance and friction the bicycle ergometer was generally calibrated before and after each experiment, and the data thus obtained used for calculating the amount of work done in any given experiment. While the storage battery was avail-

able for calibrations it was not available for the long experimental periods of eight hours per day for nine or more consecutive days, and consequently we had to rely on the 220-volt city current to magnetize the fields of the ergometer. The fluctuations of this current, while no greater than that commonly found in city circuits, were so great as to introduce serious error in this method of measurement of work, though probably for the total eight hours the fluctuations tended to counterbalance.

The necessity for much greater accuracy in the determination of the amount of external muscular work done was deemed of such importance

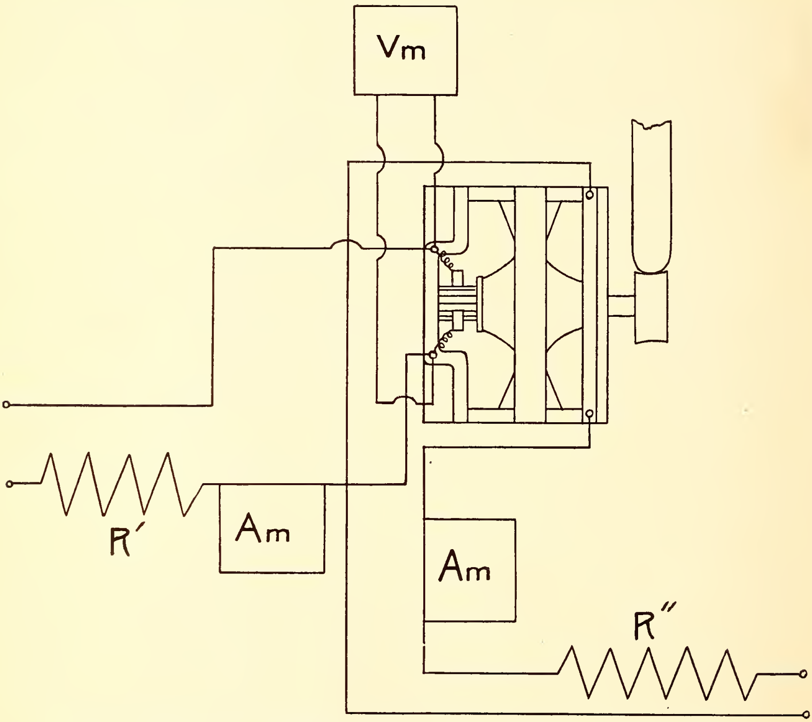

FIG. 14.—Electrical connections for second method of calibrating bicycle ergometer.

that a new form of ergometer based on an entirely different principle has been devised and calibrated and is at present in use. It has proved extremely satisfactory. By means of this new ergometer it is believed to be possible to measure with reasonable accuracy the external muscular work done in a given time. The description of the apparatus, together with the experiments made with it, await publication in detail.

ACCURACY OF THE APPARATUS AND METHODS—TEST EXPERIMENTS.

The potential energy of the food, which is one of the factors of the income of the body, and that of the unoxidized materials of the

excreta, which belongs to the outgo, is determined by the bomb calorimeter. In the transformation of potential to kinetic energy in the body the larger part, including that of internal muscular and other work, leaves the body in the form of heat and is measured partly as heat absorbed by the current of cold water which passes through the heat-absorbing pipes in the chamber and partly as heat carried out of the chamber in water vapor. The external muscular work in these experiments, except in one case, was performed on the stationary bicycle-dynamo described above. Accordingly, in testing the accuracy of the respiration calorimeter, the carbon dioxid, water, and heat given off within the chamber in the rest experiments must be determined, while in the work experiments the accuracy of the bicycle ergometer as a measure of the muscular work done must also be determined, as already explained (page 32).

Beginning with heat determinations it is necessary to take into account that which is carried away in the water vapor. This is computed from the amount of water vapor and its latent heat of vaporization. For the latent heat of evaporation the factor 0.592 has been used which is deduced from Regnault's formula,[a] as modified by an obvious correction.[b] Although this is probably reasonably accurate it would be of advantage to verify it by other determinations made under conditions similar to those existing in the respiration calorimeter. Indeed, some preliminary experiments have been made in this laboratory along this line, but the results are hardly sufficient for use.

To give conclusive evidence regarding the accuracy of the respiration calorimeter and the methods, two series of check tests were devised and employed. The novel feature of the apparatus being its use as a calorimeter, it was desirable to have a special test which could frequently be used for checking the accuracy of the measurements of heat. By passing a current of electricity through a resistance coil inside the apparatus, and measuring the current and voltage, a known amount of heat could be generated inside the chamber, and this amount compared with that obtained by direct measurement by means of the calorimeter. The method formerly used for determining the heat generated inside the apparatus involved the use of a Kelvin balance with copper voltmeters.[c] It was found that by the use of a specially constructed voltmeter and milli-ammeter the more elaborate connections of the former system could be dispensed with. The Weston Electrical Instrument Company, of Newark, N. J., furnished us with a voltmeter and milli-ammeter that they guaranteed to give readings to within one-tenth of 1 per cent—an accuracy sufficient for our work. As a matter of fact, from time to time both these instruments have been compared with a large Weston standard voltmeter, and the

[a] Mém. Acad. Roy. Sci. Inst. France, 26 (1862), p. 886.
[b] U. S. Dept. Agr., Office of Experiment Stations Bul. 63, p. 58.
[c] Ibid., p. 39.

milli-ammeter with a Kelvin balance. In general no noticeable differences were observed. The present arrangement consists of a 100-ohm resistance coil of German-silver wire, capable of carrying 1½ amperes, which is suspended inside the calorimeter chamber, and proper connections made with the voltmeter for determining the voltage at the ends of the coil. A current from a storage battery is first passed through a variable resistance, and then through the Weston milli-ammeter, and finally through the resistance coil in the chamber. Readings on both electrical instruments are made with a reading glass, and are accurate to 1 part in 1,000. This method of testing the calorimeter is very satisfactory and a test can be made in a few hours.

Inasmuch as but one (heat) of the factors measured with the respiration calorimeter in experiments with men is determined by this method, a second method was devised whereby known quantities of heat, carbon dioxid, and water could be liberated within the chamber and consequently compared with the amounts as found by actual measurement by means of the apparatus. It was found that a high-grade commercial ethyl alcohol when burned in a simple Argand (kerosene) lamp was completely oxidized to carbon dioxid and water. The heat liberated from 1 gram of this alcohol was determined by actual combustion in the bomb calorimeter and the amount of carbon dioxid and water calculated from the composition of the alcohol.[a] In general the alcohol used in these experiments was not far from 90 per cent ethyl hydroxid by weight. From these data the calculation of the amount of carbon dioxid and water vapor liberated by the combustion of 1 gram of alcohol is easily made.

Since the respiration calorimeter was completed 27 check experiments (see Table 1, page 37), in which ethyl alcohol was burned in the respiration chamber, have been made in sufficient detail to serve as true tests of the accuracy of the apparatus, 10 of these, viz, Nos. 18–27, belong with metabolism experiments Nos. 35–55 here described.

Alcohol check experiment No. 18 was begun December 4, 1900, and was followed immediately by metabolism experiments Nos. 35 and 36, although the carbon dioxid found was higher than the theoretical amount. At the close of this experiment test experiment No. 19 was made, which gave low figures for carbon dioxid and water. This was followed in January, 1901, by metabolism experiments Nos. 37–39. In February test experiment No. 20 was made, giving very satisfactory results, and was followed immediately by metabolism experiments Nos. 40–42. Test experiment No. 21 gave a very high figure for the water, but No. 22, which followed it two weeks later, gave satisfactory results, and was followed by metabolism experiments Nos. 43–48 without further tests, although these experiments were made at intervals during a period of six weeks.

[a] U. S. Dept. Agr., Office of Experiment Stations Buls. 63, p. 50; 69, p. 9.

The next test experiment, No. 23, was made in March, 1902, and as the water determination was 3 per cent too high, a second test experiment, No. 24, followed it in the same month. In this experiment the determination of water as well as that of the heat was too high. Four days later a third test experiment, No. 25, was made. While the results were satisfactory so far as carbon dioxid and heat are concerned, the water determination still remained somewhat higher than the theoretical value. These tests were followed by metabolism experiments Nos. 49–51.

In April test experiment No. 26 was made, and a high percentage of water was again found.

The following table gives the summary of all the test experiments made with the respiration calorimeter, of which, as was stated before, the last ten were made in connection with the present experiments.

TABLE 1.—*Summary of alcohol check experiments Nos. 1–27.*

No.	Date.	Duration.		Alcohol burned.	Carbon dioxid.		
					Found.	Required.	Ratio of amount found to amount required.
		Hrs.	*min.*	*Grams.*	*Grams.*	*Grams.*	*Per cent.*
1	Apr. 27–29, 1897	52	31	955.4	1,657.6	1,657.2	100.0
2	May 10–11, 1897	29	56	798.8	1,384.4	1,385.6	99.9
3	May 26–27, 1897	33	50	505.4	887.8	876.7	101.3
4	Oct. 27–28, 1897	34	33	797.7	[1,335.7	1,384.8	96.5]
5	Nov. 2– 3, 1897	35	9	788.2	1,376.7	1,365.1	100.8
6	Dec. 2, 1897	11	39	245.3	417.6	423.1	98.6
7	Jan. 6, 1898	5	50	112.2	193.5	193.5	100.0
8	Jan. 24–27, 1898	77	57	1,607.8	2,769.7	2,784.4	99.5
9	May 9, 1898	35	55	699.7	1,198.9	1,206.9	99.4
10	Nov. 3– 4, 1898	35	44	666.7	1,163.9	1,159.8	100.3
11	Nov. 15–16, 1898	35	0	751.2	1,293.7	1,304.2	99.2
12	Dec. 13–14, 1898	27	56	619.4	1,067.7	1,075.4	99.3
13	Feb. 24–25, 1899	24	0	545.7	943.9	947.8	99.6
14	Mar. 29–31, 1899	52	40	1,001.6	1,744.6	1,738.9	100.3
15	Dec. 13–14, 1899	37	40	825.4	1,424.9	1,428.6	99.7
16	Dec. 19–21, 1899	26	12	438.7	753.2	759.3	99.2
17	Apr. 6– 7, 1900	29	59	539.2	928.8	933.3	99.5
18	Dec. 4– 6, 1900	39	15	579.7	1,109.9	1,074.6	103.3
19	Dec. 14–15, 1900	36	2	652.1	1,108.1	1,134.8	97.6
20	Feb. 22–23, 1901	36	36	768.1	1,309.1	1,334.3	98.1
21	Mar. 7– 8, 1901	21	9	389.5	673.5	676.6	99.5
22	Mar. 22–23, 1901	12	0	206.1	357.3	358.0	99.8
23	Mar. 5– 8, 1902	68	37	1,313.2	2,322.2	2,291.2	101.4
24	Mar. 12–14, 1902	53	4	948.6	1,661.7	1,654.6	100.4
25	Mar. 18–20, 1902	54	31	1,053.2	1,850.2	1,837.5	100.7
26	Apr. 11–12, 1902	30	13	577.6	1,021.0	1,007.8	101.3
27	May 1– 2, 1902	29	17	578.2	[923.9	1,009.0	91.6]
1– 9[a]	1897–98	317	20	6,510.5	9,878.2	9,891.7	100.1
10–17[a]	1898–1900	269	11	5,387.9	9,320.7	9,346.8	99.7
18–27[a]	1900–1902	380	44	7,066.3	10,982.3	10,984.0	100.0

[a] Omitting carbon dioxid in Nos. 4 and 27; water in Nos. 3, 4, 16, and 17, and heat in Nos. 14, 15, and 24.

TABLE 1.—*Summary of alcohol check experiments Nos. 1–27*—Continued.

No.	Date.	Duration.		Alcohol burned.	Water.		
					Found.	Required.	Ratio of amount found to amount required.
		Hrs.	*min.*	*Grams.*	*Grams.*	*Grams.*	*Per cent.*
1	Apr. 27–29, 1897	52	31	955.4	1,109.7	1,106.1	100.3
2	May 10–11, 1897	29	56	798.8	925.0	924.8	100.0
3	May 26–27, 1897	33	50	505.4	[627.9	585.1	107.3]
4	Oct. 27–28, 1897	34	33	797.7	[1,007.9	925.7	108.8]
5	Nov. 2– 3, 1897	35	9	788.2	920.8	912.3	100.9
6	Dec. 2, 1897	11	39	245.3	287.5	283.7	101.3
7	Jan. 6, 1898	5	50	112.2	131.3	129.8	101.2
8	Jan. 24–27, 1898	77	57	1,607.8	1,881.6	1,860.8	101.1
9	May 9, 1898	35	55	699.7	807.9	809.3	99.8
10	Nov. 3– 4, 1898	35	44	666.7	773.5	772.5	100.1
11	Nov. 15–16, 1898	35	0	751.2	878.2	869.8	101.0
12	Dec. 13–14, 1898	27	56	619.4	705.7	717.2	98.4
13	Feb. 24–25, 1899	24	0	545.7	643.4	631.9	101.4
14	Mar. 29–31, 1899	52	40	1,001.6	1,187.0	1,159.7	102.4
15	Dec. 13–14, 1899	37	40	825.4	945.9	955.1	99.0
16	Dec. 19–21, 1899	26	12	438.7	527.7	507.6	103.8
17	Apr. 6– 7, 1900	29	59	539.2	[653.9	623.8	104.8]
18	Dec. 4– 6, 1900	39	15	579.7	762.9	750.2	101.7
19	Dec. 14–15, 1900	36	2	652.1	745.5	757.4	98.4
20	Feb. 22–23, 1901	36	36	768.1	900.0	889.6	101.1
21	Mar. 7– 8, 1901	21	9	389.5	[473.2	451.0	104.9]
22	Mar. 22–23, 1901	12	0	206.1	243.3	238.6	102.0
23	Mar. 5– 8, 1902	68	37	1,313.2	1,570.8	1,521.6	103.2
24	Mar. 12–14, 1902	53	4	948.6	[1,148.3	1,098.8	104.5]
25	Mar. 18–20, 1902	54	31	1,053.2	1,247.9	1,220.4	102.2
26	Apr. 11–12, 1902	30	13	577.6	[698.5	669.2	104.4]
27	May 1– 2, 1902	29	17	578.2	[726.1	670.0	108.4]
1– 9[a]	1897–98	317	20	6,510.5	6,063.8	6,027.3	100.6
10–17[a]	1898–1900	269	11	5,387.9	5,133.7	5,106.4	100.5
18–27[a]	1900–1902	380	44	7,066.3	8,225.9	7,974.8	103.1

No.	Date.	Duration.		Alcohol burned.	Heat.		
					Found.	Required.	Ratio of amount found to amount required.
		Hrs.	*min.*	*Grams.*	*Calories.*	*Calories.*	*Per cent.*
1	Apr. 27–29, 1897	52	31	955.4	6,077	6,129	99.2
2	May 10–11, 1897	29	56	798.8	5,167	5,124	100.8
3	May 26–27, 1897	33	50	505.4	3,217	3,242	99.2
4	Oct. 27–28, 1897	34	33	797.7	5,142	5,121	100.4
5	Nov. 2– 3, 1897	35	9	788.2	5,050	5,048	100.0
6	Dec. 2, 1897	11	39	245.3	1,557	1,565	99.5
7	Jan. 6, 1898	5	50	112.2	731	716	102.1
8	Jan. 24–27, 1898	77	57	1,607.8	10,269	10,295	99.7
9	May 9, 1898	35	55	699.7	4,466	4,463	100.1

[a] Omitting carbon dioxid in Nos. 4 and 27; water in Nos. 3, 4, 16, and 17, and heat in Nos. 14, 15, and 24.

TABLE 1.—*Summary of alcohol check experiments Nos. 1–27*—Continued.

No.	Date.	Duration.		Alcohol burned.	Heat.		
					Found.	Required.	Ratio of amount found to amount required.
		Hrs.	*min.*	*Grams.*	*Calories.*	*Calories.*	*Per cent.*
10	Nov. 3– 4, 1898	35	44	666.7	4,269	4,289	99.5
11	Nov. 15–16, 1898	35	0	751.2	4,844	4,823	100.5
12	Dec. 13–14, 1898	27	56	619.4	3,960	3,977	99.6
13	Feb. 24–25, 1899	24	0	545.7	3,498	3,504	99.8
14	Mar. 29–31, 1899	52	40	1,001.6	[6,223	6,431	96.7]
5	Dec. 13–14, 1899	37	40	825.4	[5,145	5,283	97.5]
16	Dec. 19–21, 1899	26	12	438.7	2,802	2,808	99.7
17	Apr. 6– 7, 1900	29	59	539.2	3,465	3,451	100.3
18	Dec. 4– 6, 1900	39	15	579.7	3,624	3,660	99.0
19	Dec. 14–15, 1900	36	2	652.1	3,736	3,731	100.1
20	Feb. 22–23, 1901	36	36	768.1	4,408	4,408	100.0
21	Mar. 7– 8, 1901	21	9	389.5	2,230	2,235	100.2
22	Mar. 22–23, 1901	12	0	206.1	1,194	1,183	100.9
23	Mar. 5– 8, 1902	68	37	1,313.2	7,621	7,573	100.6
24	Mar. 12–14, 1902	53	4	948.6	[5,584	5,469	102.1]
25	Mar. 18–20, 1902	54	31	1,053.2	6,104	6,073	100.5
26	Apr. 11–12, 1902	30	13	577.6	3,321	3,331	99.7
27	May 1– 2, 1902	29	17	578.2	3,353	3,334	100.6
1– 9[a]	1897–98	317	20	6,510.5	41,676	41,757	99.8
10–17[a]	1898–1900	269	11	5,387.9	22,845	22,893	99.8
18–27[a]	1900–1902	380	44	7,066.3	34,288	34,230	100.2

[a] Omitting carbon dioxid in Nos. 4 and 27; water in Nos. 3, 4, 16, and 17, and heat in Nos. 14, 15, and 24.

The discrepancies in the alcohol check experiments Nos. 21–27 call for a word of comment. It will be observed that the chief difficulties were in the determinations of water. In nearly every case the carbon dioxid determinations were satisfactory, as were also those of heat except in so far as they were probably affected by errors in the determinations of the amount of moisture. It will be remembered that a certain amount of heat is used in evaporating the water which is brought out of the chamber by the air current, and that the amount of heat thus brought out is measured by the amount of moisture. Any circumstance, therefore, which will introduce an error into the moisture determination introduces a corresponding error in the heat determination. Water has been found to be the most difficult factor for accurate determination in these experiments. As already explained (see page 17), there was apparently a condensation of moisture on the inner surface of the valve box which seemed to affect the accuracy of some of its determinations. It was also difficult to absolutely prevent leakage of air into the apparatus, although the errors so introduced were small.[a]

[a] For a fuller discussion of the influence of these errors on the metabolism experiments proper see page 89, metabolism experiments Nos. 52–55.

DETAILS OF METABOLISM EXPERIMENTS NOS. 35–55.

The present section is devoted to the details of experiments Nos. 35–55, inclusive. Their relation to the other experiments in order of time and in general character is indicated in the chronological list (Table 69, page 101).

GENERAL DESCRIPTION OF THE EXPERIMENTS.

Questions studied.—Aside from the general purpose of obtaining data regarding the transformations of matter and energy and the output of carbon dioxid and heat under different conditions of work and rest and at different periods of the day, these experiments had four specific objects, namely:

(1) The study of the relation between muscular work and the metabolism of matter and energy; this involves the question of the efficiency of the body as a prime motor; (2) the comparison of carbohydrates and fats as sources of energy for muscular work; (3) the obtaining of positive proof that the energy of protein is used for muscular work, and (4) the study of the metabolism of matter and energy when fasting.

Subject.—Experiments Nos. 35–55 were all made with one subject, Mr. J. C. Ware, a student in Wesleyan University. He was 22 years of age at the beginning of the experiments, stood 5 feet 10 inches in his stockings, had a chest measure of 37 inches, and weighed, in his underclothes, about 76 kilograms (168 pounds). His general build is symmetrical, his shoulders are broad, and his muscles very well developed. Although this was the first time he had served as a subject, he, like the subjects of the previous experiments, did not find the confinement in the chamber uncomfortable. His naturally excellent health and robust physique were well adapted to the demands of the "work experiments" which he engaged in. That he had been a leading bicycle rider on the "Varsity" track team was a special reason for selecting him as a subject. The fact that he worked sixteen hours during one day of experiment No. 55 and felt no unusual fatigue shows that the choice was well made.

Work, rest, and fasting experiments.—The majority of the experiments were so-called work experiments in which the subject was engaged for eight hours per day in riding the stationary bicycle which was connected with a dynamo and served as an ergometer, as described on page 30. The amount of work done was regarded as reasonable and not at all excessive. In experiment No. 55, however, he rode the ergometer sixteen hours in one day and the amount of work was large. In the rest experiments he remained as quiet as was consistent with comfort, the only muscular work being that necessitated by undressing and dressing, folding and unfolding the bed, chair, and table,

caring for the excreta, and weighing himself and the absorbers. Most of the time was spent in reading, writing, or reclining on the bed. In four rest experiments, one of two days and three of one day each, he fasted, the other conditions being the same as before.

Ration—Proportion of nutrients.—A basal or standard ration was chosen for each set of experiments. The menu was simple, the diet being made up of ordinary food materials, such as were agreeable to the subject and was as varied and palatable as was consistent with convenient preparation and accurate sampling. The nutrients were generally in such proportions as to maintain the body nearly in nitrogen and carbon equilibrium under the conditions of each experiment, whether work or rest, though the proportion of protein was purposely rather small in order the better to test the effect of the fats and carbohydrates. In some of the experiments with the more severe work, however, the food was insufficient to meet the demand and the body drew more or less heavily upon its previously stored material, as was of course the case (and in a still larger degree) in fasting experiments.

Food materials and preparation.—Much care was observed in preparing the food materials and in taking samples for analysis. With the exception of the milk, which varied somewhat in composition and was analyzed each day, the proper quantity of each kind of food, either for each meal or for a whole day, was placed in glass jars before the experiment began, materials which might spoil during the course of the experiment, such as bread and meat, being sterilized and most of them kept in a refrigerator.

The meat selected was lean beef which was specially prepared through the kindness of Armour & Co., of Chicago. The meat of a rather lean animal was freed as completely as practicable from fat and sealed in tin cans by the method usually followed in preparing canned boiled beef. By this process a portion of the extractives (meat bases) is also removed. This canned meat is palatable and has kept in the cans for several years without any apparent deterioration in flavor or otherwise. The deviled ham used in a few cases was one of the well-known commercial preparations of ham with spices, sold in tin cans. The graham crackers (sometimes called biscuit) were a commercial product said to be made of graham (wheat) flour. They are prepared without yeast, and contain but little water. The ginger snaps used were also one of the ordinary commercial brands. They were small, thin, dry cakes made of flour and supposed to be sweetened with molasses and flavored with ginger. The shredded-wheat biscuit, a commercial product, apparently contained nothing but wheat, shredded without the removal of the bran, and roasted. The "cereal coffee" used was a decoction made from one of the brands now manufactured in the United States. The bread was ordinary wheat bread from a local bakery. After the loaves were received at the laboratory, the brown

crust was removed, the interior white crumb cut in small pieces and weighed portions sealed in glass fruit jars.

With the food thus prepared before the experiment began, the preparation of a meal consisted solely in making a decoction of the cereal coffee, measuring the required quantities of milk and selecting the proper cans of meat, bread, or other food materials.

Collection of feces.—The feces evacuated each day were dried and the total amount for the experiment mixed and reserved for analysis. The separations in each case were effected by means of lampblack, taken in a gelatin capsule with the meal just preceding the experiment and with the last meal of the experiment.

Collection of urine.—The urine for each experimental day was collected in two six-hour, one four-hour, and one eight-hour period. A small portion of each collection was immediately analyzed and another reserved as part of a composite sample of the urine for the day. A sample of this was analyzed and the balance preserved by adding formalin was used in making a composite sample for the whole experiment.

Analysis of food, feces, and urine.—When the food required for a series of experiments was prepared a sample of each kind (excepting milk), was reserved for analysis, especial care being taken to secure a representative sample. The milk was analyzed daily, a sample being taken when the supply for the day was measured out for use.

Samples of the total dried feces for the whole experiment were analyzed. The total amounts of the several ingredients present divided by the number of days covered by the experiment were assumed to represent the amounts excreted per day. This assumption is commonly made in such experiments and is probably incorrect, but with the uniformity of food, exercise, and other conditions, and the general regularity of the digestive and excretive functions, it is believed that the variations from day to day are not great enough to affect the results materially.

The amount, specific gravity, and nitrogen content of the urine of each day were determined in samples of the portions collected at the four, the eight and the two six-hour intervals. The nitrogen content and heat of combustion of the unoxidized material in the urine were determined both for the day and for the whole experiment. The carbon and hydrogen content were determined in the composite sample of the whole experiment or series of experiments, and the amounts divided among the different days in proportion to the amount of nitrogen found in the urine on those days.[a]

Methods of analysis.—The ordinary determinations of water, nitrogen, ether extract, and ash were made according to the methods recommended by the Association of Official Agricultural Chemists,[b]

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[a] U. S. Dept. Agr., Office of Experiment Stations Bul. 69, pp. 21 and 35.

[b] U. S. Dept. Agr., Bureau of Chemistry Bul. 46 rev.

with such modifications of apparatus and methods as have been found of advantage. The carbon and hydrogen were determined according to the modified Liebig method, using soda lime as an absorbent of carbon dioxid.[a]

The determinations of heat of combustion were made with the form of bomb calorimeter which has been in use in this laboratory for a number of years, and which has recently been described in detail.[b]

Determination of heat, water vapor, and carbon dioxid.—The determinations of heat, water vapor, and carbon dioxid given off from the body, were made for two-hour periods, and the complete data show the total amounts as determined for each day of the experiments for periods ending at 9 a. m., 11 a. m., 1 p. m., 3 p. m., 5 p. m., 7 p. m., 9 p. m., 11 p. m., 1 a. m., 3 a. m., 5 a. m., and 7 a. m.

Division of experimental days into periods by hours.—The experiments are divided into days of twenty-four hours each, beginning and ending at 7 a. m. These days are divided into four periods, namely, two six-hour or day periods—from 7 a. m. to 1 p. m., and from 1 p. m. to 7 p. m.—and one four and one eight-hour night period—from 7 p. m. to 11 p. m., and from 11 p. m. to 7 a. m. The original plan was to divide the day into four six-hour periods, but this was abandoned as it was found that the subject, after being called at 1 a. m. to pass his urine, did not usually fall asleep again readily.

The hour of 7 a. m. was selected as the beginning of the experimental day, because it is believed that the condition of the body as regards the materials in the alimentary canal and of carbohydrates and oxygen in the fluids and tissues would be more nearly constant, from day to day, after a night's rest and after the longest period between meals than at any other time.

Number of days in each experiment.—Each individual experiment covered from one to four experimental days, and was intended as a test of some particular diet or other condition. A change of diet or other important factor meant a change of experiment. Each experiment has its serial number. (See chronological list of experiments on page 101.)

Division of experiments into series.—The experiments were carried out in series, each including from two to four experiments and lasting from five to ten days, and being intended for the comparison of two different diets. In several cases the last experiment of the series was of a single day's duration and the subject fasted. The 21 experiments here described were all made with J. C. W. and were divided into seven series.

Preliminary digestion experiments.—Each series of respiration calorimeter experiments or "metabolism" experiments, as they are called,

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[a] F. G. Benedict, Elementary Organic Analysis, Easton, Pa., 1900.

[b] Jour. Amer. Chem. Soc., 25 (1903), p. 659.

was preceded by a preliminary digestion experiment in which the food, exercise, and other conditions were as nearly as practicable the same as in the first metabolism experiment of the series and which served to accustom the subject to the diet, to bring the body into approximate nitrogen and carbon equilibrium, to test the digestibility of the food under conditions such as ordinarily obtain and learn whether the digestibility was affected to any considerable degree by the sojourn in the respiration chamber. Any necessary change in the diet was made during this period.

Preliminary night.—The subject entered the calorimeter on the evening of the last day of the preliminary digestion experiment and retired at about 11 o'clock. During this night, which is not included in the experiment proper, the observer outside was enabled to bring the inner air and metal walls of the chamber, and the inner air jacket surrounding the latter, to the desired temperature of 20° C., or thereabouts, while the proportions of carbon dioxid and water in the chamber reached those of the experiment. Thus equilibrium of temperature, carbon dioxid, and water was obtained before the beginning of the metabolism experiment.

Order of experiments and series.—The accompanying table will show the order of arrangement of the series of metabolism experiments with the corresponding preliminary experiments.

TABLE 2.—*Duration and character of metabolism experiments Nos. 35–55 and corresponding preliminary periods.*

	Duration.	Character of diet.	Physical condition.
Series 12, Dec. 5–14, 1900:	*Days.*		
Preliminary digestion experiment No. 189	4	Carbohydrate	Rest.
Metabolism experiment No. 35	4	do	Do.
Metabolism experiment No. 36	1	Fasting	Do.
Series 13, Jan. 8–20, 1901:			
Preliminary digestion experiment No. 192	3	Carbohydrate	Work.
Metabolism experiment No. 37	4	do	Do.
Metabolism experiment No. 38	4	Fat	Do.
Metabolism experiment No. 39	1	Fasting	Rest.
Series 14, Feb. 22–Mar. 7, 1901:			
Preliminary digestion experiment No. 195	4	Carbohydrate	Work.
Metabolism experiment No. 40	4	do	Do.
Metabolism experiment No. 41	4	Fat	Do.
Metabolism experiment No. 42	1	Fasting	Rest.
Series 15, Mar. 25–Apr. 7, 1901:			
Preliminary digestion experiment No. 198	4	Fat	Work.
Metabolism experiment No. 43	4	do	Do.
Metabolism experiment No. 44	4	Carbohydrate	Do.
Metabolism experiment No. 45	1	Fat	Do.
Series 16, Apr. 29–May 12, 1901:			
Preliminary digestion experiment No. 202	4	do	Do.
Metabolism experiment No. 46	4	do	Do.
Metabolism experiment No. 47	4	Carbohydrate	Do.
Metabolism experiment No. 48	1	Fat	Do.

TABLE 2.—*Duration and character of metabolism experiments Nos. 35–55, etc.*—Continued.

	Duration.	Character of diet.	Physical condition.
	Days.		
Series 17, Mar. 23–Apr. 2, 1902:			
Preliminary digestion experiment No. 302	4	Carbohydrate	Work.
Metabolism experiment No. 49	3	do	Do.
Metabolism experiment No. 50	1	Fat [a]	Do. [b]
Metabolism experiment No. 51	2	Fasting	Rest.
Series 18, Apr. 17–May 1, 1902:			
Preliminary digestion experiment No. 305	4	Fat	Work.
Metabolism experiment No. 52	3	do	Do.
Metabolism experiment No. 53	3	Carbohydrate	Do.
Metabolism experiment No. 54	3	Fat	Do.
Metabolism experiment No. 55	1	do	Do. [c]

[a] Only $1\frac{1}{2}$ meals. [b] Only 5 hours. [c] Extra work, 16 hours.

Daily programmes of experiments.—A uniform programme was followed on all days of the "rest" experiments and a similarly fixed routine on each day of the "work" experiments, with the exceptions of Nos. 50 and 55, which were peculiar in their character and will be explained in detail further on. The following is the daily programme for all "rest" experiments:

TABLE 3.—*Daily programme for rest experiments.*

6.50 a.m.	Take pulse and temperature.	3.00 p.m.	Drink 150 grams water.
7.00 a.m.	Pass urine, weigh self in underclothes, weigh absorbers.	6.00 p.m.	Supper, drink 150 grams water.
		6.50 p.m.	Take pulse and temperature.
7.45 a.m.	Breakfast, drink 150 grams water.	7.00 p.m.	Pass urine.
10.00 a.m.	Drink 150 grams water.	9.00 p.m.	Drink 100 grams water.
12.50 p.m.	Take pulse and temperature.	10.20 p.m.	Take pulse and temperature.
1.00 p.m.	Pass urine.	10.30 p.m.	Drink 100 grams water.
1.15 p.m.	Dinner, drink 200 grams water.	11.00 p.m.	Pass urine, retire.

The above programme also applies to the "fasting" experiments Nos. 36, 39, 42, and 51, except that of course no food was eaten.

The following is the daily programme for all "work" experiments, with the exceptions noted above:

TABLE 4.—*Daily programme for work experiments.*

6.50 a. m.	Take pulse and temperature.	2.00 p. m.	Begin work.
7.00 a. m.	Pass urine, weigh self in underclothes, collect drip, and weigh absorbers.	3.00 p. m.	Weigh absorbers.
		4.00 p. m.	Stop work, drink water.
		4.15 p. m.	Begin work.
7.30 a. m.	Breakfast, drink water.	5.00 p. m.	Weigh absorbers.
8.15 a. m.	Begin work.	6.15 p. m.	Stop work, change underclothing.
9.00 a. m.	Weigh absorbers.	6.20 p. m.	Supper, drink water.
10.15 a. m.	Stop work, drink water.	6.50 p. m.	Take pulse and temperature.
10.30 a. m.	Begin work.	7.00 p. m.	Pass urine, weigh self in underclothes, collect drip, and weigh absorbers.
11.00 a. m.	Weigh absorbers.		
12.30 p. m.	Stop work.		
12.50 p. m.	Take pulse and temperature.	9.00 p. m.	Drink water, weigh absorbers.
1.00 p. m.	Pass urine, collect drip, and weigh absorbers.	10.00 p. m.	Take pulse and temperature.
		11.00 p. m.	Arrange bed, weigh absorbers, pass urine, retire.
1.25 p. m.	Dinner, drink water.		

Detailed statistics—Appendix tables.—The details of the experiments here reported, which are desirable for reference but are not a necessary part of the narrative, will be found in the Appendix. The results of the analyses of food, feces, and urine for all the experiments will be found in Appendix Tables 109–116; the determinations of the income and outgo of carbon, hydrogen and nitrogen in food, feces, urine, perspiration and respiration, and the determinations of income and outgo of energy in Tables 117–122; and the measurements of heat and external muscular work in Tables 123–126.

A description of experiments Nos. 35–55, with a summary of the results obtained, follows.

METABOLISM EXPERIMENTS NOS. 35 AND 36—REST EXPERIMENTS WITH ORDINARY DIET AND WITH FASTING.

The preliminary digestion experiment began with breakfast, December 4, 1900, and continued five days, the subject remaining quiet in the laboratory during the day. As this was the first experiment of the season, and also the first ever made with this subject, more time than usual was required to adjust the amounts of food materials to his taste and bodily demands; hence the extra length of the preliminary period.

The subject entered the respiration chamber on the afternoon of December 8, and experiment No. 35 began at 7 a. m., December 9, and continued until 7 a. m., December 13. The main object of the experiment was to find how much protein and energy the subject required to maintain carbon and nitrogen equilibrium with a minimum amount of muscular exercise. The data obtained during the preliminary digestion experiment showed about how much food he was inclined to take when at rest and thus gave a basis for determining the exact ration for the metabolism experiment proper. Fortunately the amount decided upon proved to be just about sufficient to maintain the desired equilibrium.

The diet consisted of ordinary food materials and furnished 97.7 grams of protein and 2,519 calories of energy, about one-half of the total energy being supplied by carbohydrates.

In order to get light, if possible, upon the amount of energy required for the digestion of the food, the supper of the preliminary night and the second and fourth days of the experiment was delayed until 10.45 p. m.

Experiment No. 36, which began at 7 a. m., December 13, and lasted one day, was a fasting experiment, during which no food was given to the subject, but he was allowed all the water he desired. He did not drink more than the ordinary allowance, nor did he suffer any inconvenience whatever from his fasting.

Statistics of food and feces.—The amounts and composition of the food and feces of experiment No. 35 are shown in detail in Tables 5 and 6 herewith.

TABLE 5.—*Weight, composition, and heat of combustion of foods, metabolism experiment No. 35.*

Laboratory No.	Food material.	Weight per day.	Water.	Protein.	Fat.	Carbohydrates.	Nitrogen.	Carbon.	Hydrogen.	Heat of combustion.
		Grams.	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Calories.*
3241	Beef	100	61.2	35.1	3.1	....	5.62	20.05	2.90	227
3242	Butter	25	2.6	.5	21.1	....	.08	15.77	2.50	194
3244	Whole milk	850	726.8	32.3	45.1	39.9	5.10	67.74	9.94	768
3245	Bread	300	123.9	22.2	12.0	139.2	3.90	82.53	12.24	835
3246	Shredded-wheat biscuit	50	4.1	4.8	.7	39.7	.84	20.46	2.87	204
3247	Ginger snaps	50	3.3	2.8	3.6	39.2	.50	21.12	3.07	212
	Sugar	20	....	....	....	20.0	....	8.42	1.30	79
	Total, 1 day	1,395	921.9	97.7	85.6	278.0	16.04	236.09	34.82	2,519

TABLE 6.—*Weight, composition, and heat of combustion of feces, metabolism experiment No. 35.*

Laboratory No.		Weight.	Water.	Protein.	Fat.	Carbohydrates.	Nitrogen.	Carbon.	Hydrogen.	Heat of combustion.
		Grams.	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Calories.*
3249	Total, 4 days	395.3	310.7	30.7	16.2	25.3	4.91	39.93	5.69	440
	Average, 1 day	98.8	77.7	7.7	4.0	6.3	1.23	9.98	1.42	110

Statistics of urine.—The amount and composition of the urine of experiments Nos. 35 and 36, which are given in detail in Tables 113 and 114 of the Appendix, are summarized in Table 7 herewith.

TABLE 7.—*Amount and composition of urine, metabolism experiments Nos. 35 and 36.*

Experiment No.	Date.	Amount.	Nitrogen.	Carbon.	Hydrogen.	Water.	Heat of combustion.
	1900.	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Calories.*
35	Dec. 9–10	1,513.4	17.18	12.78	3.23	1,451.7	142
	10–11	1,239.7	15.61	11.62	2.94	1,184.3	133
	11–12	1,501.5	15.38	11.44	2.90	1,445.7	132
	12–13	1,428.8	15.22	11.33	2.86	1,373.8	133
	Total, 4 days	5,683.4	63.39	47.17	11.93	5,455.5	540
36	Dec. 13–14	1,400.0	11.49	8.55	2.16	1,357.1	95

Carbon dioxid and water in ventilating air current.—The methods employed for the determinations of carbon dioxid and water in the

incoming and outgoing air current have been described in previous reports[a] and on pages 26 and 29. The detailed results for experiments Nos. 35 and 36 are given in Appendix, Tables 117–121, and summarized in Table No. 8 which follows.

TABLE 8.—*Record of carbon dioxid and water in ventilating air current, metabolism experiments Nos. 35 and 36.*

Experiment No.	Date.	(a) Volume of air.	Carbon dioxid. (b) In incoming air.	(c) In outgoing air.	(d) Correction for amount remaining in chamber.	(e) Amount exhaled by subject, c+d—b.	(f) Total carbon in respiratory products, $e \times \frac{3}{11}$.	Water. (g) In incoming air.	(h) In outgoing air.	(i) Correction for amount remaining in chamber.	(k) Total water of respiration and perspiration, h+i—g.
	1900.	*Liters.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
35	Dec. 9–10	117,375	66.5	879.7	−2.1	811.1	221.2	85.2	1,042.1	−2.6	954.3
	10–11	117,375	67.9	874.4	+1.2	807.7	220.3	80.4	951.2	−1.0	869.8
	11–12	116,598	67.6	887.0	+1.8	821.2	224.0	79.6	939.7	+2.8	862.9
	12–13	114,267	67.7	875.6	+ .4	808.3	220.5	80.2	918.7	−1.5	837.0
	Total, 4 days..	465,615	269.7	3,516.7	+1.3	3,248.3	886.0	325.4	3,851.7	−2.3	3,524.0
36	Dec. 13–14	116,140	65.9	772.7	+4.3	711.1	193.9	81.0	850.2	−1.1	768.1

Heat given off from the body.—In experiment No. 35 the amount of food was not quite sufficient to meet the demands of the body, so that there was a slight loss of body material, and in experiment No. 36 there was no food, and the body necessarily drew upon its previously stored material. In these experiments there was no appreciable amount of external muscular work. All of the energy which resulted from the transformation of the food and body material in these experiments left the body as heat, since none was stored as latent energy of reserve material. This heat was carried away mainly in the current of water which passed through the heat absorbers, but part was rendered latent by the evaporation of the water of respiration and perspiration and was carried away with vapor in the outgoing air current. The statistics involved in the measurements of the heat which thus left the body are given in Tables 118 and 119 of the Appendix and summarized in Table 9 herewith.

[a] U. S. Dept. Agr., Office of Experiment Stations Buls. 63 and 109.

TABLE 9.—*Summary of calorimetric measurements, metabolism experiments Nos. 35 and 36.*

Experiment No.	Date.	(a) Heat carried away by water current.	(b) Correction for temperature of food and dishes and changes in temperature of calorimeter.	(c) Heat rendered latent in evaporization of water.	(d) Total heat determined, $a+b+c$.
	1900.	*Calories.*	*Calories.*	*Calories.*	*Calories.*
35	Dec. 9–10	1,857.6	− 8.7	565.0	2,413.9
	10–11	1,852.7	+18.6	515.0	2,386.3
	11–12	1,878.6	+23.4	510.9	2,412.9
	12–13	1,868.9	+10.5	495.4	2,374.8
	Total, 4 days	7,457.8	+43.8	2,086.3	9,587.9
36	Dec. 13–14	1,780.1	+17.9	454.8	2,252.8

Balance of income and outgo of matter and energy.—From the details in Tables 122–126 of the Appendix, and the data included in the tables given above, the income and outgo of nitrogen, carbon, hydrogen, and energy are computed, as shown in Tables 10–13 below, the methods of computation being indicated by letters and formulas in the column headings. Thus, for instance, in Table 10 the nitrogen in food is given in the column lettered (*a*), that in feces in column (*b*), etc. The formula $a-(b+c)$, given in the heading to column (*d*), indicates that the values in that column are found by subtracting from those in column (*a*) the sum of those in columns (*b*) and (*c*). Nitrogen gained or lost, column (*d*), is used in the computations in Table 12. In the latter table the protein gained or lost, column (*b*), is computed from the nitrogen in column (*a*), which is the same as column (*d*), Table 10, by multiplying by the usual factor 6.25, assuming that protein is 16 per cent nitrogen. The carbon in the protein gained or lost, column (*d*), is the product of the values in column (*b*) and the factor 0.53, on the assumption that protein is 53 per cent carbon. Total carbon gained or lost, column (*c*), Table 12, is found from Table 10; the difference between the values in columns (*c*) and (*d*) is the carbon in fat gained or lost, column (*e*), and these values divided by 0.7608 give the fat gained or lost, column (*f*), on the assumption that fat is 76.08 per cent carbon.

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TABLE 10.—*Income and outgo of nitrogen and carbon, metabolism experiments Nos. 35 and 36.*

Date.	Nitrogen. (a) In food.	(b) In feces.	(c) In urine.	(d) Gain (+) or loss (−), a−(b+c).	Carbon. (e) In food.	(f) In feces.	(g) In urine.	(h) In respiratory products.	(i) Gain (+) or loss (−), e−(f+g+h).
1900.									
Experiment No. 35.	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
Dec. 9–10	16.0	1.2	17.2	− 2.4	236.1	9.9	12.8	221.2	− 7.8
10–11	16.1	1.2	15.6	− .7	236.1	10.0	11.6	220.3	− 5.8
11–12	16.0	1.2	15.4	− .6	236.1	10.0	11.5	224.0	− 9.4
12–13	16.1	1.3	15.2	− .4	236.1	10.0	11.3	220.5	− 5.7
Total, 4 days	64.2	4.9	63.4	− 4.1	944.4	39.9	47.2	886.0	− 28.7
Average, 1 day	16.0	1.2	15.8	− 1.0	236.1	10.0	11.8	221.5	− 7.2
Experiment No. 36.									
Dec. 13–14	....	....	11.5	−11.5	....	....	8.6	193.9	−202.5

TABLE 11.—*Income and outgo of water and hydrogen, metabolism experiments Nos. 35 and 36.*

Date.	Water. (a) In food.	(b) In drink.	(c) In feces.	(d) In urine.	(e) In respiratory products.	(f) Apparent loss, a+b−(c+d+e).
1900.						
Experiment No. 35.	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
Dec. 9–10	921.9	1,000	77.6	1,451.7	954.3	− 561.7
10–11	921.9	1,000	77.7	1,184.3	869.8	− 209.9
11–12	921.9	1,000	77.7	1,445.7	862.9	− 464.4
12–13	921.9	1,000	77.7	1,373.8	837.0	− 366.6
Total, 4 days	3,687.6	4,000	310.7	5,455.5	3,524.0	−1,602.6
Average, 1 day	921.9	1,000	77.7	1,363.9	881.0	− 400.7
Experiment No. 36.						
Dec. 13–14	....	1,000	....	1,357.1	768.1	−1,125.2

Date.	Hydrogen. (g) In food.	(h) In feces.	(i) In urine.	(k) Apparent gain, g−(h+i).	(l) Loss from water, f÷9.	(m) Total gain (+) or loss (−), k+l.
1900.						
Experiment No. 35.	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
Dec. 9–10	34.9	1.5	3.2	+ 30.2	− 62.4	− 32.2
10–11	34.8	1.4	2.9	+ 30.5	− 23.3	+ 7.2
11–12	34.8	1.4	2.9	+ 30.5	− 51.6	− 21.1
12–13	34.8	1.4	2.9	+ 30.5	− 40.7	− 10.2
Total, 4 days	139.3	5.7	11.9	+121.7	−178.0	− 56.3
Average, 1 day	34.8	1.4	3.0	+ 30.4	− 44.5	− 14.1
Experiment No. 36.						
Dec. 13–14	....	....	2.2	− 2.2	−125.0	−127.2

TABLE 12.—*Gain or loss of protein ($N \times 6.25$), fat, and water, metabolism experiments Nos. 35 and 36.*

Date.	(*a*) Nitrogen gained (+) or lost (−).	(*b*) Protein gained (+) or lost (−), $a \times 6.25$.	(*c*) Total carbon gained (+) or lost (−).	(*d*) Carbon in protein gained (+) or lost (−), $b \times 0.53$.	(*e*) Carbon in fat, etc., gained (+) or lost (−), $c-d$.	(*f*) Fat gained (+) or lost (−), $e \div 0.7608$.
1900.						
Experiment No. 35.	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
Dec. 9–10	− 2.4	−15.0	− 7.8	− 8.0	+ 0.2	+ 0.3
10–11	− .7	− 4.4	− 5.8	− 2.3	− 3.5	− 4.6
11–12	− .6	− 3.7	− 9.4	− 2.0	− 7.4	− 9.7
12–13	− .4	− 2.5	− 5.7	− 1.3	− 4.4	− 5.8
Total, 4 days	− 4.1	−25.6	− 28.7	−13.6	− 15.1	− 19.8
Average, 1 day	− 1.0	− 6.4	− 7.2	− 3.4	− 3.8	− 5.0
Experiment No. 36.						
Dec. 13–14	−11.5	−71.9	−202.5	−38.1	−164.4	−216.1

Date.	(*g*) Total hydrogen gained (+) or lost (−).	(*h*) Hydrogen in protein gained (+) or lost (−), $b \times 0.07$.	(*i*) Hydrogen in fat gained (+) or lost (−), $f \times 0.118$.	(*k*) Hydrogen in water, etc., gained (+) or lost (−), $g-(h+i)$.	(*l*) Water gained (+) or lost (−), $k \times 9$.
1900.					
Experiment No. 35.	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
Dec. 9–10	− 32.2	−1.0	0.0	−31.2	−280.8
10–11	+ 7.2	− .3	− .5	+ 8.0	+ 72.0
11–12	− 21.1	− .3	− 1.1	−19.7	−177.3
12–13	− 10.2	− .2	− .7	− 9.3	− 83.7
Total, 4 days	− 56.3	−1.8	− 2.3	−52.2	−469.8
Average, 1 day	− 14.1	− .4	− .6	−13.1	−117.5
Experiment No. 36.					
Dec. 13–14	−127.2	−5.0	−25.5	−97.2	−874.8

TABLE 13.—*Income and outgo of energy, metabolism experiments Nos. 35 and 36.*

Date.	(*a*) Heat of combustion of food eaten.	(*b*) Heat of combustion of feces.	(*c*) Heat of combustion of urine.	(*d*) Estimated heat of combustion of protein, gained (+) or lost (−).	(*e*) Estimated heat of combustion of fat, gained (+) or lost (−).	(*f*) Estimated energy of material oxidized in the body, $a-(b+c+d+e)$.	(*g*) Heat determined.	(*h*) Heat determined, greater (+) or less (−) than estimated, $g-f$.	(*i*) Heat determined, greater (+) or less (−) than estimated, $h \div f$.
1900.									
Experiment No. 35.	*Calories.*	*Calories.*	*Calories.*	*Calories.*	*Calories.*	*Calories.*	*Calories.*	*Calories.*	*Per cent.*
Dec. 9–10	2,519	110	142	− 85	+ 3	2,349	2,414	+ 65	+2.8
10–11	2,519	110	133	− 25	− 44	2,345	2,386	+ 41	+1.7
11–12	2,519	110	132	− 21	− 93	2,391	2,413	+ 22	+ .9
12–13	2,519	110	133	− 14	− 55	2,345	2,375	+ 30	+1.3
Total, 4 days	10,076	440	540	−145	− 189	9,430	9,588	+158	....
Average, 1 day	2,519	110	135	− 36	− 47	2,357	2,397	+ 40	+1.7
Experiment No. 36.									
Dec. 13–14	....	....	95	−406	−2,062	2,373	2,253	−120	−5.1

METABOLISM EXPERIMENTS NOS. 37–39.

The purpose of this series was to obtain data regarding the relative fuel values or replacing powers of sugar and fat as parts of a ration for muscular work. The series included three individual experiments, Nos. 37, 38, and 39. In the first two, which were of four days each, the subject had food and worked on the bicycle ergometer, while in the third, which continued only one day, he fasted and did no work. In experiment No. 37 carbohydrates and in experiment No. 38 fats predominated in the diet. The series as usual was preceded by a preliminary digestion experiment of four days in which the diet was similar to that in experiment No. 37.

At 4.30 p. m. on the fourth day of the preliminary digestion experiment the subject went into the respiration chamber of the calorimeter for the preliminary night, and experiment No. 37 began at 7 a. m. on the following day.

The diet in experiments Nos. 37 and 38 included a basal ration, which was the same for both, and a supplementary ration, that for No. 37 supplying carbohydrates, mostly in the form of cane sugar or milk sugar, and that for No. 38, fats, mostly in the form of milk fat, i. e., butter. The results show that the diets in both these experiments were insufficient to meet the demands of the body with the amount of muscular work which was done.

The work done in experiments Nos. 37 and 38 consisted in pedaling the bicycle ergometer described on page 30 for eight hours per day. The subject was an expert bicyclist and was thus able to perform a fairly large amount of work. During the four days of the preliminary digestion experiment he took nearly the same amount of exercise, using, however, a stationary bicycle, a so-called "home-trainer."

In the experiments previously described each day was divided into four periods of six hours each. In view of the results thus obtained it seemed desirable to divide the day into two-hour periods, as regards determinations of carbon dioxid, water of respiration and perspiration, and heat given off from the body.

During the working hours the amount of water vapor given off by respiration and perspiration was considerable and more or less moisture condensed upon the absorbers. These were accordingly weighed every two hours from 7 a. m. to 11 p. m.; at night no appreciable amount of water was condensed upon them and the weighing when the subject was asleep was not necessary.

Inasmuch as more or less nitrogenous matter is given off in the perspiration, steps were taken to determine approximately the amounts of nitrogen thus excreted. The method was essentially the same as previously described.[a] Just before entering the chamber the subject

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[a] U. S. Dept. Agr., Office of Experiment Stations Bul. No. 69.

took a bath in ordinary water and then washed himself carefully with distilled water. He was provided with several suits of underclothing (undershirts and drawers) of rather thin cotton, each of which had been washed in ordinary water, rinsed in distilled water, and dried. When needed, a suit was weighed and passed into the chamber through the food aperture. It was worn through the working period of the day and then was taken off, placed in a cylindrical holder of metal with a tight cover, passed out and weighed again. The increase in weight with correction for urea, etc., in solution was taken as water of perspiration and an allowance was made for it in calculating the total amount of water given off from the body. To determine the amounts of nitrogen in the perspiration, the suit was washed and rinsed in distilled water, all of which was evaporated to small volume and the nitrogen in it determined by the Kjeldahl method. The quantities of nitrogen thus found were small, as shown by the figures in Table 78 beyond.

The subject was in an excellent physical condition during the entire experiment and slept soundly every night.

Experiment No. 39 began at 7 a. m. on January 19 and lasted one day. The subject received no food, and no drink except water, and remained as quiet as was convenient. He suffered no special inconvenience, though he was not quite as comfortable as in the previous fasting experiment, No. 36.

The urine for the day of fasting was collected according to the general usage in these experiments, i. e., that passed at 7 in the morning was included with that of the previous day; that passed during the fasting day and up to and including that passed at 7 a. m. the following day was taken as belonging to the fasting period.

The feces corresponding to the last meal of the previous experiment were passed the second morning after this meal. In the computations of the results of this experiment no allowance is made for the nitrogen or energy of the digestive juices poured into the intestine after the passage of the feces belonging to the previous experiment. The amount of the error thus introduced we have found, in the previous experiments, to be so small as to be entirely negligible.

Detailed statistics of income and outgo.—Tables 14–18 give the details of income and outgo of matter and energy in this series of experiments.

The amounts, composition, and heats of combustion of food and feces in experiments Nos. 37 and 38 are given in Tables 14 and 15 herewith.

TABLE 14.—*Weight, composition, and heat of combustion of foods, metabolism experiments Nos. 37 and 38.*

Laboratory No.	Food material.	Weight per day.	Water.	Protein.	Fat.	Carbohydrates.	Nitrogen.	Carbon.	Hydrogen.	Heat of combustion.
	Basal ration.	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Calories.*
3256	Bread	250	106.8	18.0	5.8	117.2	3.15	66.30	9.58	668
3247	Ginger snaps	50	3.3	2.8	3.6	39.2	.50	21.11	3.07	212
3246	Shredded wheat	50	4.1	4.8	.7	39.7	.84	20.47	2.87	204
	Sugar	20				20.0		8.42	1.30	79
3253	Butter	20	2.4	.3	16.9		.06	12.52	1.99	154
	Total	390	116.6	25.9	27.0	216.1	4.55	128.82	18.81	1,317
	Supplemental ration.									
	EXPERIMENT NO. 37.									
3251	Beef	85	52.1	29.0	2.4		4.64	16.96	2.46	191
3263	do	25	15.8	8.2	.7		1.32	4.81	.71	53
3255	Whole milk	500	424.0	17.5	27.5	27.5	2.80	42.65	6.15	472
3256	Bread	200	85.4	14.4	4.6	93.8	2.52	53.04	7.66	534
3257	Graham crackers	50	1.7	4.0	5.1	38.6	.70	22.96	3.40	232
3247	Ginger snaps	25	1.8	1.4	1.8	19.6	.25	10.56	1.53	106
	Cane sugar	120				120.0		50.52	7.78	475
3258	Milk sugar	90	4.6			85.4		36.00	5.54	335
	Total	1,095	585.4	74.5	42.1	384.9	12.23	237.50	35.23	2,398
	Total, 1 day	1,485	702.0	100.4	69.1	601.0	16.78	366.32	54.04	3,715
	EXPERIMENT NO. 38.									
3251	Beef	25	15.3	8.5	.7		1.37	4.99	.72	56
3263	do	25	15.8	8.2	.7		1.32	4.81	.71	53
3252	Deviled ham	75	28.9	11.6	31.0		1.85	29.41	4.61	356
3262	Whole milk	1,350	1,146.2	47.2	67.5	79.6	7.56	110.70	16.60	1,231
3253	Butter	90	11.0	1.2	75.9		.27	56.32	8.94	695
	Total	1,565	1,217.2	76.7	175.8	79.6	12.37	206.23	31.58	2,391
	Total, 1 day	1,955	1,333.8	102.6	202.8	295.7	16.92	335.05	50.39	3,708

TABLE 15.—*Weight, composition, and heat of combustion of feces, metabolism experiments Nos. 37 and 38.*

Laboratory No.		Weight.	Water.	Protein.	Fat.	Carbohydrates.	Nitrogen.	Carbon.	Hydrogen.	Heat of combustion.
	Experiment No. 37.	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Calories.*
3260	Feces for 4 days	414.5	317.1	39.6	15.8	29.8	6.33	46.63	6.55	506
	Average, 1 day	103.6	79.3	9.9	3.9	7.4	1.58	11.66	1.64	126
	Experiment No. 38.									
3261	Feces for 4 days	471.9	360.5	30.3	27.4	30.7	4.84	53.89	7.93	612
	Average, 1 day	118.0	90.1	7.6	6.8	7.7	1.21	13.47	1.98	153

The amounts and composition of the urine for experiments Nos. 37–39, which are given in detail in Tables 113 and 114 of the Appendix, are summarized in Table 16.

TABLE 16.—*Amount and composition of urine, metabolism experiments Nos. 37–39.*

Experiment No.	Date.	Amount.	Nitrogen.	Carbon.	Hydrogen.	Water.	Heat of combustion.
	1901.	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Calories.*
37	Jan. 11–12	1,369.5	15.18	11.61	2.95	1,309.7	130
	12–13	883.0	14.65	11.21	2.85	828.8	104
	13–14	819.6	17.07	13.06	3.31	758.1	143
	14–15	910.7	19.40	14.84	3.77	840.9	154
	Total, 4 days	3,982.8	66.30	50.72	12.88	3,737.5	531
38	Jan. 15–16	954.4	19.52	14.93	3.79	883.9	153
	16–17	1,036.3	20.27	15.51	3.93	962.8	157
	17–18	1,020.9	20.34	15.56	3.95	947.2	156
	18–19	1,021.6	20.96	16.04	4.07	945.9	155
	Total, 4 days	4,033.2	81.09	62.04	15.74	3,739.8	621
39	Jan. 19–20	1,310.4	15.96	12.21	3.10	1,248.5	131
37–39	Total, 9 days	9,326.4	163.35	124.97	31.72	8,725.8	1,283

The amounts of carbon dioxid and water given off in respiration and perspiration are shown in Table 17. (See Tables 117–121, Appendix, for details.)

TABLE 17.—*Record of carbon dioxid and water in ventilating air current, metabolism experiments Nos. 37–39.*

Experiment No.	Date.	(*a*) Volume of air.	Carbon dioxid. (*b*) In incoming air.	(*c*) In outgoing air.	(*d*) Correction for amount remaining in chamber.	(*e*) Amount exhaled by subject, *c*+*d*−*b*.	(*f*) Total carbon in respiratory products, *e*×3/11.	Water. (*g*) In incoming air.	(*h*) In outgoing air.	(*i*) Correction for amount remaining in chamber.	(*k*) Total water of respiration and perspiration, *h*+*i*−*g*.
	1901.	*Liters.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
37	Jan. 11–12	117,375	69.2	1,679.9	0.0	1,610.7	439.3	92.8	1,315.0	+1,289.5	2,511.7
	12–13	117,375	68.2	1,826.1	−1.4	1,756.5	479.0	93.0	1,354.5	+1,762.8	3,024.3
	13–14	118,152	70.3	1,778.0	−1.7	1,706.0	465.2	92.5	1,354.1	+1,581.4	2,843.0
	14–15	117,375	71.5	1,620.1	+1.1	1,549.7	422.7	88.2	1,282.7	+1,116.2	2,310.7
	Total	470,277	279.2	6,904.1	−2.0	6,622.9	1,806.2	366.5	5,306.3	+5,749.9	10,689.7
38	Jan. 15–16	117,375	71.5	1,572.7	+ .6	1,501.8	409.5	93.1	1,293.4	+1,106.3	2,306.6
	16–17	115,044	69.9	1,584.1	−1.1	1,513.1	412.6	96.0	1,308.5	+1,416.5	2,629.0
	17–18	118,152	68.0	1,523.0	+ .8	1,455.8	397.0	94.0	1,336.2	+1,277.3	2,519.5
	18–19	119,707	67.6	1,494.6	−2.3	1,424.7	388.5	84.1	1,327.9	+1,199.9	2,443.7
	Total	470,278	277.0	6,174.4	−2.0	5,895.4	1,607.6	367.2	5,266.0	+5,000.0	9.898.8
39	Jan. 19–20	117,375	67.9	711.1	+5.7	648.9	177.0	74.9	1,080.1	− 182.9	822.3

Table 18 summarizes the calorimetric determinations made during these experiments. (See Tables 123 and 124, Appendix, for details.)

TABLE 18.—*Summary of calorimetric measurements, metabolism experiments Nos. 37–39.*

Experiment No.	Date.	(*a*) Heat carried away by water current.	(*b*) Correction for temperature of food and dishes and changes in temperature of calorimeter.	(*c*) Heat rendered latent by vaporization of water.	(*d*) Total heat determined, $a+b+c$.	(*e*) Heat equivalent of external muscular work.
	1901.	*Calories.*	*Calories.*	*Calories.*	*Calories.*	*Calories.*
37	Jan. 11–12	3,858.6	+ 40.5	728.0	4,627.1	487.8
	12–13	4,282.4	+ 6.1	746.6	5,035.1	527.3
	13–14	4,162.1	+ 29.8	745.0	4,936.9	527.2
	14–15	3,711.7	+ 38.6	707.2	4,457.5	480.9
	Total, 4 days	16,014.8	+115.0	2,926.8	19,056.6	2,023.2
38	Jan. 15–16	3,779.4	+ 25.3	711.3	4,516.0	491.3
	16–17	3,866.4	+ 22.8	718.2	4,607.4	496.3
	17–18	3,674.3	+ 22.7	734.8	4,431.8	494.8
	18–19	3,588.5	+ 27.7	735.6	4,351.8	498.0
	Total, 4 days	14,908.6	+ 98.5	2,899.9	17,907.0	1,980.4
39	Jan. 19–20	1,395.1	+ 39.2	592.7	2,027.0	....

Balance of income and outgo of matter and energy.—From the preceding tables the income and outgo of nitrogen, carbon, hydrogen, and energy are computed and the results summarized in Tables 19–22. Formulas in the headings of the columns show how most of the results were derived. (For details see Tables 117–124 of the Appendix and the preceding tables of experiments Nos. 37–39.)

TABLE 19.—*Income and outgo of nitrogen and carbon, metabolism experiments Nos. 37–39.*

Date.	Nitrogen.				Carbon.				
	(*a*) In food.	(*b*) In feces.	(*c*) In urine.*	(*d*) Gain (+) or loss (—), $a-(b+c)$.	(*e*) In food.	(*f*) In feces.	(*g*) In urine.*	(*h*) In respiratory products.	(*i*) Gain (+) or loss (—), $e-(f+g+h)$.
1901.									
Experiment No. 37.	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
Jan. 11–12	16.7	1.5	15.5	− 0.3	366.3	11.7	11.7	439.3	− 96.4
12–13	16.8	1.6	15.0	+ .2	366.4	11.6	11.4	479.0	−135.6
13–14	16.8	1.6	17.4	− 2.2	366.3	11.7	13.3	465.2	−123.9
14–15	16.8	1.6	19.8	− 4.6	366.3	11.6	14.9	422.7	− 82.9
Total	67.1	6.3	67.7	− 6.9	1,465.3	46.6	51.3	1,806.2	−438.8
Average, 1 day	16.8	1.6	16.9	− 1.7	366.3	11.7	12.8	451.5	−109.7
Experiment No. 38.									
Jan. 15–16	17.0	1.2	19.7	− 3.9	335.0	13.4	15.1	409.5	−103.0
16–17	16.9	1.2	20.7	− 5.0	335.1	13.5	15.6	412.6	−106.6
17–18	16.9	1.2	20.6	− 4.9	335.0	13.5	15.8	497.0	− 91.3
18–19	16.9	1.2	21.4	− 5.7	335.1	13.5	16.1	388.5	− 83.0
Total	67.7	4.8	82.4	−19.5	1,340.2	53.9	62.6	1,607.6	−383.9
Average, 1 day	16.9	1.2	20.6	− 4.9	335.1	13.5	15.6	401.9	− 96.0
Experiment No. 39.									
Jan. 19–20	....	....	16.0	−16.0	....	....	12.2	177.0	−189.2

*The perspiration for the eight days contained 2.7 grams of nitrogen, which is assumed to be in the form of urea, and would be accompanied by 0.6 gram of carbon. Accordingly these amounts of nitrogen and carbon are distributed over the eight days and are included here.

TABLE 20.—*Income and outgo of water and hydrogen, metabolism experiments Nos. 37–39.*

Date.	Water. (a) In food.	(b) In drink.	(c) In feces.	(d) In urine.	(e) In respiratory products.	(f) Apparent loss, $a+b-(c+d+e)$.
1901.						
Experiment No. 37.	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
Jan. 11–12	702.0	1,900	79.2	1,309.7	2,511.7	−1,298.6
12–13	702.0	1,950	79.3	828.8	3,024.3	−1,280.4
13–14	702.0	2,100	79.3	758.1	2,843.0	− 878.4
14–15	702.0	2,250	79.3	840.9	2,310.7	− 278.9
Total	2,808.0	8,200	317.1	3,737.5	10,689.7	−3,736.3
Average per day	702.0	2,050	79.3	934.4	2,672.4	− 934.1
Experiment No. 38.						
Jan. 15–16	1,333.8	1,500	90.2	883.9	2,306.6	− 446.9
16–17	1,333.8	1,500	90.1	962.8	2,629.0	− 848.1
17–18	1,333.8	1,500	90.1	947.2	2,519.5	− 723.0
18–19	1,333.8	1,500	90.1	945.9	2,443.7	− 645.9
Total	5,335.2	6,000	360.5	3,739.8	9,898.8	−2,663.9
Average per day	1,333.8	1,500	90.1	935.0	2,474.7	− 666.0
Experiment No. 39.						
Jan. 19–20	....	1,950	....	1,248.5	822.3	− 120.8

Date.	Hydrogen. (g) In food.	(h) In feces.	(i) In urine.	(k) Apparent gain, $g-(h+i)$.	(l) Loss from water, $f\div 9$.	(m) Total gain (+) or loss (−), $k+l$.
1901.						
Experiment No. 37.	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
Jan. 11–12	54.0	1.6	3.0	49.4	−144.3	− 94.9
12–13	54.1	1.7	2.8	49.6	−142.3	− 92.7
13–14	54.0	1.6	3.3	49.1	− 97.6	− 48.5
14–15	54.1	1.7	3.8	48.6	− 31.0	+ 17.6
Total	216.2	6.6	12.9	196.7	−415.2	−218.5
Average per day	54.0	1.6	3.2	49.2	−103.8	− 54.6
Experiment No. 38.						
Jan. 15–16	50.4	1.9	3.8	44.7	− 49.7	− 5.0
16–17	50.4	2.0	3.9	44.5	− 94.2	− 49.7
17–18	50.4	2.0	3.9	44.5	− 80.3	− 35.8
18–19	50.4	2.0	4.1	44.3	− 71.8	− 27.5
Total	201.6	7.9	15.7	178.0	−296.0	−118.0
Average per day	50.4	2.0	3.9	44.5	− 74.0	− 29.5
Experiment No. 39.						
Jan. 19–20	....	....	3.1	−3.1	− 13.4	− 16.5

TABLE 21.—*Gain or loss of protein ($N \times 6.25$), fat, and water, metabolism experiments Nos. 37–39.*

Date.	(*a*) Nitrogen gained (+) or lost (−).	(*b*) Protein gained (+) or lost (−), $a \times 6.25$.	(*c*) Total carbon gained (+) or lost (−).	(*d*) Carbon in protein gained (+) or lost (−), $b \times 0.53$.	(*e*) Carbon in fat, etc., gained (+) or lost (−). $c-d$.	(*f*) Fat gained (+) or lost (−), $e \div 0.7608$.
1901.						
Experiment No. 37.	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
Jan. 11–12	− 0.3	− 1.9	− 96.4	− 1.0	− 95.4	−125.4
12–13	+ .2	+ 1.3	−135.6	+ .7	−136.3	−179.1
13–14	− 2.2	− 13.8	−123.9	− 7.3	−116.6	−153.3
14–15	− 4.6	− 28.7	82.9	−15.3	− 67.7	− 89.0
Total	− 6.9	− 43.1	−438.8	−22.9	−416.0	−546.8
Average per day	− 1.7	− 10.8	−109.7	− 5.7	−104.0	−136.7
Experiment No. 38.						
Jan. 15–16	− 3.9	− 24.4	−103.0	−12.9	− 90.1	−118.4
16–17	− 5.0	− 31.3	−106.6	−16.6	− 90.0	−118.3
17–18	− 4.9	− 30.6	− 91.3	−16.2	− 75.1	− 98.7
18–19	− 5.7	− 35.6	− 83.0	−18.9	− 64.1	− 84.3
Total	−19.5	−121.9	−383.9	−64.6	−319.3	−419.7
Average per day	− 4.9	− 30.5	− 96.0	−14.2	− 79.8	−104.9
Experiment No. 39.						
Jan. 19–20	−16.0	−100.0	−189.2	−53.0	−136.2	−179.0

Date.	(*g*) Total hydrogen gained (+) or lost (−).	(*h*) Hydrogen in protein gained (+) or lost (−), $b \times 0.07$.	(*i*) Hydrogen in fat gained (+) or lost (−), $f \times 0.118$.	(*k*) Hydrogen in water, etc., gained (+) or lost (−), $g-(h+i)$.	(*l*) Water gained (+) or lost (−), $k \times 9$.
1901.					
Experiment No. 37.	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
Jan. 11–12	− 94.9	−0.1	−14.8	− 80.0	− 720.0
12–13	− 92.7	+ .1	−21.1	− 71.7	− 645.3
13–14	− 48.5	−1.0	−18.1	− 29.4	− 264.6
14–15	+ 17.6	−2.0	−10.5	+ 30.1	+ 270.9
Total	−218.5	−3.0	−64.5	−151.0	−1,359.0
Average per day	− 54.6	− .7	−16.1	− 37.8	− 339.8
Experiment No. 38.					
Jan. 15–16	− 5.0	−1.7	−14.0	+ 10.7	+ 96.3
16–17	− 49.7	−2.2	−14.0	− 33.5	− 301.5
17–18	− 35.8	−2.1	−11.6	− 22.1	− 198.9
18–19	− 27.5	−2.5	− 9.9	− 15.1	− 135.9
Total	−118.0	−8.5	−49.5	− 60.0	− 540.0
Average per day	− 29.5	−2.1	−12.4	− 15.0	− 135.0
Experiment No. 39.					
Jan. 19–20	− 16.5	−7.0	−21.1	+ 11.6	+ 104.4

TABLE 22.—*Income and outgo of energy, metabolism experiments Nos. 37–39.*

Date.	(*a*) Heat of combustion of food eaten.	(*b*) Heat of combustion of feces.	(*c*) Heat of combustion of urine.	(*d*) Estimated heat of combustion of protein gained (+) or lost (−).	(*e*) Estimated heat of combustion of fat gained (+) or lost (−).	(*f*) Estimated energy of material oxidized in the body, *a*−(*b*+*c*+*d*+*e*).	(*g*) Heat determined.	(*h*) Heat determined greater (+) or less (−) than estimated, *f*−*g*.	(*i*) Heat determined greater (+) or less (−) than estimated, *h*÷*f*.
1901.									
Experiment No. 37.	*Calories.*	*Calories.*	*Calories.*	*Calories.*	*Calories.*	*Calories.*	*Calories.*	*Calories.*	*Per cent.*
Jan. 11–12..........	3,715	127	130	− 11	−1,196	4,665	4,627	− 38	−0.8
12–13..........	3,715	126	104	+ 7	−1,709	5,187	5,035	−152	−2.9
13–14..........	3,715	127	143	− 78	−1,462	4,985	4,937	− 48	−1.0
14–15..........	3,715	126	154	−162	− 849	4,446	4,458	+ 12	+ .3
Total	14,860	506	531	−244	−5,216	19,283	19,057	−226	....
Average, 1 day.	3,715	126	133	− 61	−1,304	4,821	4,764	− 57	−1.2
Experiment No. 38.									
Jan. 15–16..........	3,708	153	153	−138	−1,130	4,670	4,516	−154	−3.3
16–17..........	3,708	153	157	−177	−1,128	4,703	4,607	− 96	−2.0
17–18..........	3,708	153	156	−173	− 942	4,514	4,432	− 82	−1.8
18–19..........	3,708	153	155	−201	− 804	4,405	4,352	− 53	−1.2
Total	14,832	612	621	−689	−4,004	18,292	17,907	−385	....
Average, 1 day.	3,708	153	155	−172	−1,001	4,573	4,477	− 96	−2.1
Experiment No. 39.									
Jan. 19–20..........	....	....	131	−565	−1,708	2,142	2,027	−115	−5.4

METABOLISM EXPERIMENTS NOS. 40–42.

This series of experiments was similar to the previous in purpose and plan. That is to say, there were two work experiments (Nos. 40 and 41) of four days each, in which a diet containing an excess of fat was compared with one supplying an excess of carbohydrates, these periods being followed by a fasting experiment of one day, i. e., experiment No. 42.

As the diet in the preceding series proved too small to meet the demands of the body when the subject was doing an amount of muscular work which he felt to be by no means excessive, it was increased in experiments Nos. 40 and 41 by the addition of sufficient fats and carbohydrates to make the energy value about 4,520 calories per day, the quantity of protein being kept nearly the same as in the previous series. The basal ration was made up of the usual materials and furnished 45.8 grams of protein and 1,544 calories of energy. The supplemental ration in experiment No. 40 consisted of sugar and starchy foods, such as bread, graham crackers, etc., furnishing about 37.8 grams of protein and 2,564 calories of energy. Some extra milk was also given, making the total protein 101.2 grams and the total energy 4,523 calories. The supplemental ration in experiment No. 41 con-

sisted of additional butter and milk and furnished 56.8 grams of protein and 2,995 calories of energy, making the total protein 102.6 grams and the total energy 4,539 calories.

In experiment No. 40 about 75 per cent of the entire energy was furnished by the carbohydrates, and in experiment No. 41 about 60 per cent by the fats. Nevertheless, in both cases the diet was entirely palatable to the subject.

The amount of work was the same as before, namely, eight hours per day spent in pedaling the bicycle ergometer. The preliminary digestion experiment began with breakfast on February 22, 1901, and lasted four days, being divided into two subperiods of two days each, one for testing the carbohydrate diet and one for testing the fat diet, to determine whether the subject would be able to tolerate food supplying such excessive amounts of energy-yielding constituents.

It was intended that the ration with a large amount of fat—experiment No. 41—should be made up of the same materials as in experiment No. 38 of the previous series, but during the preliminary digestion experiments the subject found that so much deviled ham as was used in experiment No. 38, taken in connection with the large amount of butter needed in the present experiment, was extremely distasteful. The deviled ham was therefore omitted after the first day of the preliminary period and enough milk added to supply the nitrogen lost by its omission and enough butter to supply the needed energy.[a]

With breakfast on February 24 the diet was changed to that which was intended for metabolism experiment No. 40, with the exception that at the close of the first day of experiment No. 40 the diet was again slightly altered by adding 30 grams of sugar and omitting 50 grams of milk from the basal ration.

At 4 o'clock on the afternoon of February 25 the subject entered the calorimeter, and the regular determinations were begun at 7 p. m., although, as before, the experiment proper did not begin until 7 a. m. on the following morning. The separation of feces was made by giving charcoal with supper, and was not very sharp. However, the separations between the different experiments of the series and that at the end of the series were very sharp. The subject was very comfortable, indeed, except that during the first night following the change of ration he was somewhat restless.

Experiment No. 40 ended at 7 a. m. on March 2, when the diet was changed to the one furnishing an excess of fats, and experiment No. 41 began and continued until 7 a. m. on March 6.

The fasting experiment, No. 42, which began at 7 a. m. on March 6 and continued one day, was similar to experiments Nos. 36 and 39.

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[a] For details of this preliminary digestion experiment, see Connecticut (Storrs) Station Rpt. 1901, p. 216.

The subject experienced no great discomfort, and was in excellent condition on leaving the calorimeter at 7 a. m., March 7.

Detailed statistics of income and outgo.—The statistics of income and outgo of matter and energy are given in Tables 23–27 below.

The amounts and composition of the components of the basal ration are shown in Table 23, together with those for the supplemental rations used for the two experiments. The outgo of matter and energy in the feces during the successive experiments of the series is shown in Table 24.

TABLE 23.—*Weight, composition, and heat of combustion of foods, metabolism experiments Nos. 40 and 41.*

Laboratory No.	Food material.	Weight per day.	Water.	Protein.	Fat.	Carbohydrates.	Nitrogen.	Carbon.	Hydrogen.	Heat of combustion.
	Basal ration.	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Calories.*
3296	Beef	35	21.6	11.9	1.0	....	1.90	6.88	0.98	77
3298	Butter	20	2.1	.3	17.2	....	.04	12.74	2.05	158
3302	Bread	350	152.3	25.9	4.2	164.2	4.52	88.44	12.88	886
3305	Ginger snaps	60	2.4	3.6	3.4	49.2	.63	25.74	3.98	259
3304	Shredded wheat	40	2.5	4.1	.6	32.2	.72	16.70	2.54	164
	Total	505	180.9	45.8	26.4	245.6	7.81	150.50	22.43	1,544
	Supplemental ration, experiment No. 40.									
	FIRST DAY.									
3296	Beef	25	15.5	8.5	.7	....	1.36	4.92	.71	55
3302	Bread	200	87.0	14.8	2.4	93.7	2.58	50.54	7.36	507
3305	Ginger snaps	25	1.0	1.5	1.4	20.5	.26	10.72	1.66	108
3304	Shredded wheat	40	2.5	4.1	.7	32.1	.72	16.69	2.54	164
3300	Whole milk	500	425.5	19.5	26.0	25.5	3.00	39.70	5.90	462
3303	Graham crackers	100	2.7	8.9	10.9	74.6	1.56	45.37	6.69	467
3258	Milk sugar	100	5.1	....	....	94.9	....	40.00	6.15	372
	Cane sugar	195	....	....	....	195.0	....	82.10	12.64	772
	Total ration 1st day	1,690	720.2	103.1	68.5	781.9	17.29	440.54	66.08	4,451
	SECOND, THIRD, AND FOURTH DAYS.									
3296	Beef	25	15.5	8.5	.7	....	1.36	4.92	.70	55
3302	Bread	200	87.0	14.8	2.4	93.8	2.58	50.54	7.36	507
3303	Graham crackers	100	2.7	8.9	10.9	74.6	1.56	45.37	6.69	467
3305	Ginger snaps	25	1.0	1.5	1.4	20.5	.26	10.72	1.66	108
3304	Shredded wheat	40	2.5	4.1	.6	32.2	.72	16.70	2.54	164
3300	Whole milk	450	382.5	17.6	23.4	23.0	2.70	35.73	5.31	415
3258	Milk sugar	100	5.1	....	....	94.9	....	40.00	6.15	372
	Cane sugar	225	....	....	....	225.0	....	94.72	14.58	891
	Total ration 2d to 4th days	1,670	677.2	101.2	65.8	809.6	16.99	449.20	67.42	4,523
	Supplemental ration, experiment No. 41.									
3301	Whole milk	1,455	1,241.2	53.8	77.2	72.8	8.59	116.69	18.04	1,326
3298	Butter	211	21.7	3.0	181.5	....	.46	134.43	21.58	1,669
	Total ration per day	2,171	1,443.8	102.6	285.1	318.4	16.86	401,62	62.05	4,530

TABLE 24.—*Weight, composition, and heat of combustion of feces, metabolism experiments Nos. 40 and 41.*

Laboratory No.		Weight.	Water.	Protein.	Fat.	Carbohydrates.	Nitrogen.	Carbon.	Hydrogen.	Heat of combustion.
	Experiment No. 40.	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Calories.*
3307	Total, 4 days	618.1	478.4	53.5	21.6	48.2	8.56	66.56	9.39	728
	Average per day	154.5	119.6	13.4	5.4	12.0	2.14	16.64	2.35	182
	Experiment No. 41.									
3308	Total, 4 days	686.9	538.6	36.4	45.3	40.5	5.83	78.23	11.75	925
	Average per day	171.7	134.6	9.1	11.3	10.1	1.46	19.56	2.94	231

The amount and composition of urine for each day are shown in Table 25. These determinations, together with those of heats of combustion, were made in accordance with the plan outlined on page 42. (For details see Appendix, Tables 113 and 114.)

TABLE 25.—*Amount and composition of urine, metabolism experiments Nos. 40–42.*

Experiment No.	Date.	Amount.	Nitrogen.	Carbon.	Hydrogen.	Water.	Heat of combustion.
	1901.	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Calories.*
40	Feb. 26–27	891.6	15.87	11.58	3.12	834.1	130
	27–28	768.8	16.11	11.75	3.16	711.4	135
	28–Mar. 1	849.4	17.63	12.87	3.46	786.5	166
	Mar. 1–2	819.8	17.65	12.88	3.47	757.0	142
	Total, 4 days	3,329.6	67.26	49.08	13.21	3,089.0	573
41	Mar. 2–3	1,203.6	20.18	14.73	3.96	1,129.9	154
	3–4	1,760.8	20.39	14.88	4.01	1,682.4	155
	4–5	1,734.3	19.89	14.51	3.91	1,657.8	166
	5–6	1,555.8	19.63	14.32	3.86	1,481.4	156
	Total, 4 days	6,254.5	80.09	58.44	15.74	5,951.5	631
42	Mar. 6–7	1,744.7	14.11	10.30	2.77	1,686.7	108
40–42	Total, 9 days	11,328.8	161.46	117.82	31.72	10,727.2	1,312

The determinations of carbon dioxid and water are summarized in Table 26, which follows. The details will be found in Appendix, Tables 117–122.

TABLE 26.—*Record of carbon dioxid and water in ventilating air current, metabolism experiments Nos. 40–42.*

Experiment No.	Date.	(*a*) Volume of air.	Carbon dioxid. (*b*) In incoming air.	(*c*) In outgoing air.	(*d*) Correction for amounts remaining in chamber.	(*e*) Amount exhaled by subject, $c+d-b$.	(*f*) Total carbon in respiratory products, $e \times \frac{3}{11}$.	Water. (*g*) In incoming air.	(*h*) In outgoing air.	(*i*) Correction for amounts remaining in chamber.	(*k*) Total water of respiration and perspiration, $h+i-g$.
	1901.	*Liters.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
40	Feb. 26–27..	119,707	66.4	1,970.8	+1.0	1,905.4	519.7	81.5	1,312.4	+2,047.8	3,278.7
	27–28..	118,930	64.7	1,887.8	−2.1	1,821.0	496.6	83.2	1,310.4	+1,860.4	3,087.6
	Feb. 28–Mar. 1 ...	117,375	67.6	1,891.5	+1.4	1,825.3	497.8	81.9	1,286.3	+1,837.7	3,042.1
	Mar. 1–2...	116,599	66.3	1,914.5	− .6	1,847.6	503.8	90.3	1,293.9	+1,864.6	3,068.2
	Total, 4 days..	472,611	265.0	7,664.6	− .3	7,399.3	2,017.9	336.9	5,203.0	+7,610.5	12,476.6
41	Mar. 2–3...	117,375	65.8	1,813.3	+ .3	1,747.8	476.6	91.2	1,333.9	+1,991.1	3,233.8
	3–4...	116,598	64.8	1,719.0	+2.1	1,656.3	451.7	85.8	1,325.7	+1,894.5	3,134.4
	4–5...	117,375	67.8	1,727.3	−2.8	1,656.7	451.8	92.2	1,325.7	+2,106.8	3,340.3
	5–6...	115,822	66.8	1,781.5	−1.6	1,713.1	467.2	89.4	1,341.8	+2,224.0	3,476.4
	Total, 4 days..	467,170	265.2	7,041.1	−2.0	6,773.9	1,847.3	358.6	5,327.1	+8,216.4	13,184.9
42	Mar. 6–7...	116,598	65.5	685.4	− .2	619.7	169.0	76.3	1,055.6	− 137.6	841.7

Table 27 summarizes the calorimetric determinations for this series of experiments. The details are given in Appendix, Tables 123 and 124.

TABLE 27.—*Summary of calorimetric measurements, metabolism experiments Nos. 40–42.*

Experiment No.	Date.	(*a*) Heat carried away by water current.	(*b*) Correction for temperature of food and dishes and changes in temperature of calorimeter.	(*c*) Heat rendered latent by vaporization of water.	(*d*) Total heat determined, $a+b+c$.	(*e*) Heat equivalent of external muscular work.
	1901.	*Calories.*	*Calories.*	*Calories.*	*Calories.*	*Calories.*
40	Feb. 26–27	4,632.8	+ 50.3	733.9	5,417.0	513.6
	27–28	4,362.1	+ 25.9	724.4	5,112.4	510.1
	28–Mar. 1	4,420.5	+ 36.6	714.0	5,171.1	520.4
	Mar. 1–2	4,444.6	+ 33.5	713.5	5,191.6	527.2
	Total, 4 days	17,860.0	+146.3	2,885.8	20,892.1	2,071.3
41	Mar. 2–3	4,454.6	+ 41.8	736.9	5,233.3	527.2
	3–4	4,355.2	+ 43.6	733.7	5,132.5	516.0
	4–5	4,456.4	+ 35.0	730.1	5,221.5	515.3
	5–6	4,602.1	+ 35.9	741.4	5,379.4	528.0
	Total, 4 days	17,868.3	+156.3	2,942.1	20,966.7	2,086.5
42	Mar. 6–7	1,363.6	+ 8.4	574.1	1,946.1	....

Balance of income and outgo of matter and energy.—The income and outgo of nitrogen, carbon, hydrogen, and energy are shown in Tables 28–31. The details were obtained from the preceding tables, and letters at the heads of the columns show the mathematical processes by which the results were calculated. (See also Appendix, Tables 117–124.)

TABLE 28.—*Income and outgo of nitrogen and carbon, metabolism experiments Nos. 40–42.*

Date.	Nitrogen.				Carbon.				
	(*a*) In food.	(*b*) In feces.	(*c*) In urine.*	(*d*) Gain (+) or loss (−), $a-(b+c)$.	(*e*) In food.	(*f*) In feces.	(*g*) In urine.†	(*h*) In respiratory products.	(*i*) Gain (+) or loss (−), $e-(f+g+h)$.
1901.									
Experiment No. 40.	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
Feb. 26–27	17.3	2.1	16.2	− 1.0	440.5	16.6	11.7	519.7	−107.5
27–28	17.0	2.2	16.4	− 1.6	449.2	16.7	11.9	496.6	− 76.0
28–Mar. 1	17.0	2.1	17.9	− 3.0	449.2	16.6	13.0	497.8	− 78.2
Mar. 1–2	17.0	2.2	17.9	− 3.1	449.2	16.7	12.9	503.8	− 84.2
Total	68.3	8.6	68.4	− 8.7	1,788.1	66.6	49.5	2,017.9	−345.9
Average, 1 day	17.1	2.2	17.1	− 2.2	447.0	16.6	12.4	504.5	− 86.5
Experiment No. 41.									
Mar. 2–3	16.9	1.5	20.5	− 5.1	401.7	19.5	14.8	476.6	−109.2
3–4	16.8	1.4	20.7	− 5.3	401.6	19.6	15.0	451.7	− 84.7
4–5	16.9	1.5	20.2	− 4.8	401.6	19.5	14.6	451.8	− 84.3
5–6	16.8	1.4	19.8	− 4.4	401.6	19.6	14.4	467.2	− 99.6
Total	67.4	5.8	81.2	−19.6	1,606.5	78.2	58.8	1,847.3	−377.8
Average, 1 day	16.9	1.5	20.3	− 4.9	401.6	19.6	14.7	461.8	− 94.4
Experiment No. 42.									
Mar. 6–7	....	....	14.1	−14.1	....	....	10.3	169.0	−179.3

*Nitrogen in perspiration added to this column. †Carbon in perspiration added to this column.

TABLE 29.—*Income and outgo of water and hydrogen, metabolism experiments Nos. 40–42.*

Date.	Water.					
	(*a*) In food.	(*b*) In drink.	(*c*) In feces.	(*d*) In urine.	(*e*) In respiratory products.	(*f*) Apparent loss, $a+b-(c+d+e)$.
1901.						
Experiment No. 40.	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
Feb. 26–27	720.2	2,550	119.6	834.1	+3,278.7	− 962.2
27–28	677.2	2,550	119.6	711.4	+3,087.6	− 691.4
28–Mar. 1	677.2	2,800	119.6	786.5	+3,042.1	− 471.0
Mar. 1–2	677.2	2,800	119.6	757.0	+3,068.2	− 467.6
Total	2,751.8	10,700	478.4	3,089.0	+12,476.6	−2,592.2
Average, 1 day	687.9	2,675	119.6	772.3	+3,119.1	− 648.1
Experiment No. 41.						
Mar. 2–3	1,443.8	2,800	134.6	1,129.9	+3,233.8	− 254.5
3–4	1,443.8	2,800	134.7	1,682.4	+3,134.4	− 707.7
4–5	1,443.8	2,800	134.6	1,657.8	+3,340.3	− 888.9
5–6	1,443.8	2,800	134.7	1,481.4	+3,476.4	− 848.7
Total	5,775.2	11,200	538.6	5,951.5	+13,184.9	−2,699.8
Average, 1 day	1,443.8	2,800	134.7	1,487.9	+3,296.2	− 675.0
Experiment No. 42.						
Mar. 6–7	....	1,400	....	1,686.7	841.7	−1,128.4

TABLE 29.—*Income and outgo of water and hydrogen, etc.*—Continued.

Date.	Hydrogen.					
	(*g*) In food.	(*h*) In feces.	(*i*) In urine.	(*k*) Apparent gain, $g-(h+i)$.	(*l*) Loss from water, $f \div 9$.	(*m*) Total gain(+) or loss(−)$k+l$.
1901.						
Experiment No. 40.	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
Feb. 26–27	66.1	2.3	3.1	+ 60.7	−106.9	− 46.2
27–28	67.4	2.4	3.2	+ 61.8	− 76.8	− 15.0
28–Mar. 1	67.4	2.3	3.5	+ 61.6	− 52.3	+ 9.3
Mar. 1–2	67.4	2.4	3.5	+ 61.5	− 52.0	+ 9.5
Total	268.3	9.4	13.3	+245.6	−288.0	− 42.4
Average, 1 day	67.1	2.4	3.3	+ 61.4	− 72.0	− 10.6
Experiment No. 41.						
Mar. 2–3	62.1	3.0	4.0	+ 55.1	− 28.3	+ 26.8
3–4	62.0	2.9	4.0	+ 55.1	− 78.6	− 23.5
4–5	62.1	2.9	3.9	+ 55.3	− 98.8	− 43.5
5–6	62.0	2.9	3.9	+ 55.2	− 94.3	− 39.1
Total	248.2	11.7	15.8	+220.7	−300.0	− 79.3
Average, 1 day	62.1	2.9	4.0	+ 55.2	− 75.0	− 19.8
Experiment No. 42.						
Mar. 6–7	....	....	2.8	− 2.8	−125.4	−128.2

TABLE 30.—*Gain or loss of protein ($N \times 6.25$), fat, and water, metabolism experiments Nos. 40–42.*

Date.	(*a*) Nitrogen gained (+) or lost (−).	(*b*) Protein gained (+) or lost (−), $a \times 6.25$.	(*c*) Total carbon gained (+) or lost (−).	(*d*) Carbon in protein gained (+) or lost (−), $b \times 0.53$.	(*e*) Carbon in fat, etc., gained (+) or lost (−), $c-d$.	(*f*) Fat gained (+) or lost (−), $e \div 0.7608$.
1901.						
Experiment No. 40.	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
Feb. 26–27	− 1.0	− 6.3	−107.5	− 3.3	−104.2	−137.0
27–28	− 1.6	− 10.0	− 76.0	− 5.3	− 70.7	− 92.9
28–Mar. 1	− 3.0	− 18.7	− 78.2	− 9.9	− 68.3	− 89.8
Mar. 1–2	− 3.1	− 19.4	− 84.2	−10.3	− 73.9	− 97.1
Total	− 8.7	− 54.4	−345.9	−28.8	−317.1	−416.8
Average, 1 day	− 2.2	− 13.6	− 86.5	− 7.2	− 79.3	−104.2
Experiment No. 41.						
Mar. 2–3	− 5.1	− 31.9	−109.2	−16.9	− 92.3	−121.3
3–4	− 5.3	− 33.1	− 84.7	−17.5	− 67.2	− 88.3
4–5	− 4.8	− 30.0	− 84.3	−15.9	− 68.4	− 89.9
5–6	− 4.4	− 27.5	− 99.6	−14.6	− 85.0	−111.7
Total	−19.6	−122.5	−377.8	−64.9	−312.9	−411.2
Average, 1 day	− 4.9	− 30.6	− 94.4	−16.2	− 78.2	−102.8
Experiment No. 42.						
Mar. 6–7	−14.1	− 88.1	−179.3	−46.7	−132.6	−174.3

TABLE 30.—*Gain or loss of protein (N×6.25), fat, and water, etc.*—Continued.

Date.	(*g*) Total hydrogen gained (+) or lost (−).	(*h*) Hydrogen in protein gained (+) or lost (−), *b*×0.07.	(*i*) Hydrogen in fat gained (+) or lost (−), *f*×0.118.	(*k*) Hydrogen in water, etc., gained (+) or lost (−), *g*−(*h*+*i*).	(*l*) Water gained (+) or lost (−), *k*×9.
1901.					
Experiment No. 40.	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
Feb. 26–27	− 46.2	−0.4	−16.1	− 29.7	−267.3
27–28	− 15.0	− .7	−11.0	− 3.3	− 29.7
28–Mar. 1	+ 9.3	−1.3	−10.6	+ 21.2	+190.8
Mar. 1–2	+ 9.5	−1.4	−11.5	+ 22.4	+201.6
Total	− 42.4	−3.8	−49.2	+ 10.6	+ 95.4
Average, 1 day	− 10.6	− .9	−12.3	+ 2.7	+ 23.9
Experiment No. 41.					
Mar. 2–3	+ 26.8	−2.2	−14.3	+ 43.3	+389.7
3–4	− 23.5	−2.3	−10.4	− 10.8	− 97.2
4–5	− 43.5	−2.1	−10.6	− 30.8	−277.2
5–6	− 39.1	−1.9	−13.2	− 24.0	−216.0
Total	− 79.3	−8.5	−48.5	− 22.3	−200.7
Average, 1 day	− 19.8	−2.1	−12.1	− 5.6	− 50.2
Experiment No. 42.					
Mar. 6–7	−128.2	−6.2	−20.6	−101.4	−912.6

TABLE 31.—*Income and outgo of energy, metabolism experiments Nos. 40–42.*

Date.	(*a*) Heat of combustion of food eaten.	(*b*) Heat of combustion of feces.	(*c*) Heat of combustion of urine.	(*d*) Estimated heat of combustion of protein gained (+) or lost (−).	(*e*) Estimated heat of combustion of fat gained (+) or lost (−).	(*f*) Estimated energy of material oxidized in the body, *a*−(*b*+*c*+*d*+*e*).	(*g*) Heat determined.	(*h*) Heat determined greater (+) or less (−) than estimated, *f*−*g*.	(*i*) Heat determined greater (+) or less (−) than estimated, *h*÷*f*.
1901.									
Experiment No. 40.	*Calories.*	*Calories.*	*Calories.*	*Calories.*	*Calories.*	*Calories.*	*Calories.*	*Calories.*	*Per cent.*
Feb. 26–27	4,451	182	130	− 35	−1,307	5,481	5,417	− 64	−1.2
27–28	4,523	182	135	− 57	− 886	5,149	5,112	− 37	− .7
28–Mar. 1	4,523	182	166	−106	− 857	5,138	5,171	+ 33	+ .6
Mar. 1–2	4,523	182	142	−109	− 926	5,234	5,192	− 42	− .8
Total	18,020	728	573	−307	−3,976	21,002	20,892	−110	....
Average, 1 day.	4,505	182	143	− 77	− 994	5,251	5,223	− 28	− .5
Experiment No. 41.									
Mar. 2–3	4,539	232	154	−180	−1,157	5,491	5,233	−258	−4.7
3–4	4,539	231	155	−187	− 842	5,182	5,133	− 49	− .9
4–5	4,539	231	166	−170	− 858	5,170	5,222	+ 52	+1.0
5–6	4,539	231	156	−155	−1,067	5,374	5,379	+ 5	0.0
Total	18,156	925	631	−692	−3,924	21,217	20,967	−250	....
Average, 1 day.	4,539	231	158	−173	− 981	5,304	5,242	− 62	−1.2
Experiment No. 42.									
Mar. 6–7	....	....	108	−498	−1,663	2,053	1,946	−107	−5.2

METABOLISM EXPERIMENTS NOS. 43-45.

The general purpose of this series of experiments was the same as that of the previous one, namely, a comparison of the replacing power of fat and sugar as parts of a diet for muscular work, except that the order was reversed, the fat diet being taken in this case in the first test of the series. Furthermore, in the last experiment, No. 45, the subject, instead of fasting without work, as in experiments Nos. 36, 39, and 42, performed the regular amount of work and followed the same diet as in experiment No. 43.

The preliminary digestion experiment began with breakfast on March 25, 1901, and continued four days, as usual. The diet was the same as in metabolism experiment No. 43, to follow. The subject was recovering from a cold and on the first day was unable to take as much exercise as usual, and ate less than was intended; in fact, he could not eat all the fat in the ration. The second day he felt much better, took the usual exercise, and relished the entire ration. He desired additional drink, which was furnished by 400 cubic centimeters of cereal coffee decoction with each meal, and in this way the ration was made very acceptable.

He entered the calorimeter on the evening of March 28 and retired at the usual time—11 p. m. The experiment proper began at 7 a. m. on March 29. The programme followed was as shown on page 45.

Considerable trouble was experienced during this experiment in maintaining the required voltage with the ergometer, partly on account of the slipping of the wheels and partly on account of fluctuations in the field current of the dynamo. The extra effort caused the subject to perspire freely, but otherwise he was entirely comfortable.

Experiment No. 44 began at 7 a. m. on April 2, and continued four days. Considerable trouble being experienced with the ergometer during the first day, the tension of the spring holding the rear tire to the driving wheel of the dynamo was increased, and resin was applied to the strip of canvas which had been cemented to the surface of the tire where it came in contact with the pulley, and no further trouble was experienced. The subject slept well and relished his food during the experiment.

At 7 a. m. on April 6 experiment No. 45 began, the subject returning to the diet of experiment No. 43, and continuing the same rate of work as during experiments Nos. 43 and 44. The diet was not relished as well as during experiment No. 43. The subject left the chamber at 7 a. m. on April 7.

The diet in experiment No. 43 consisted of a basal ration furnishing 48.4 grams of protein and 1,848 calories of energy. This was increased by a supplementary ration of milk and butter, so that the whole ration furnished about 104 grams of protein and 4,867 calories of energy, fat supplying about 45 per cent of the latter. In experiment No. 45 the

same basal ration was used and sufficient milk and butter added so that 105.3 grams of protein and 4,860 calories of energy were furnished per day. In experiment No. 44 the same basal ration as before was increased by cane sugar, milk sugar, bread, graham crackers, and milk, so that the whole diet supplied 104.4 grams of protein and 4,932 calories of energy, of which about 76 per cent was furnished by carbohydrates.

Statistics of income and outgo.—Tables 32–36 below give the statistics of income and outgo of matter and energy in this series of experiments.

The details of the rations, including amounts, composition, and heats of combustion of the constituents, are shown in Table 32. The amounts of nutrients and energy rejected in the feces are shown in Table 33. (See Appendix, Tables 109 and 110.)

TABLE 32.—*Weight, composition, and heat of combustion of foods, metabolism experiments Nos. 43–45.*

Laboratory No.	Food material.	Weight per day.	Water.	Protein.	Fat.	Carbohydrates.	Nitrogen.	Carbon.	Hydrogen.	Heat of combustion.
	Basal ration.	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Calories.*
3309	Beef	35	22.0	11.5	1.0		1.84	6.73	0.99	76
3310	Butter	20	2.2	.2	17.0		.04	12.57	2.06	157
3314	Bread	350	148.7	28.3	3.9	165.5	4.97	90.69	13.55	913
3305	Ginger snaps	60	2.4	3.6	3.4	49.2	.63	25.74	3.98	259
3304	Shredded wheat	40	2.5	4.1	.6	32.2	.72	16.70	2.54	164
	Sugar	60				60.0		25.26	3.89	238
3321	Cereal coffee	1,200	1,191.6	.7		7.2	.12	3.96	.60	41
	Total	1,765	1,369.4	48.4	25.9	314.1	8.32	181.65	27.61	1,848
	Supplemental ration.									
	EXPERIMENT NO. 43.									
3312	Whole milk	1,355	1,149.0	52.9	74.6	69.2	8.40	108.00	16.93	1,247
3310	Butter	225	25.0	2.7	191.3		.43	141.43	23.22	1,772
	Total ration per day	3,345	2,543.4	104.0	291.8	383.3	17.15	431.08	67.76	4,867
	EXPERIMENT NO. 44.									
3313	Whole milk	450	379.4	17.1	25.2	25.2	2.74	37.22	5.76	423
3309	Beef	25	15.7	8.2	.7		1.32	4.81	.71	54
3314	Bread	200	85.0	16.2	2.2	94.6	2.84	51.80	7.74	522
3304	Shredded wheat	40	2.5	4.1	.6	32.2	.72	16.70	2.54	164
3303	Graham crackers	100	2.7	8.9	10.9	74.6	1.56	45.37	6.69	467
3305	Ginger snaps	25	1.0	1.5	1.4	20.5	.26	10.73	1.66	108
3258	Milk sugar	100	5.1			94.9		40.00	6.15	372
	Cane sugar	246				246.0		103.57	15.94	974
	Total ration per day	2,951	1,860.8	104.4	66.9	902.1	17.76	491.85	74.80	4,932
	EXPERIMENT NO. 45.									
3319	Whole milk	1,355	1,142.3	54.2	71.9	77.3	8.67	113.14	17.07	1,240
3310	Butter	225	25.0	2.7	191.3		.43	141.44	23.22	1,772
	Total ration per day	3,345	2,536.7	105.3	289.1	391.4	17.42	436.23	67.90	4,860

TABLE 33.—*Weight, composition, and heat of combustion of feces, metabolism experiments Nos. 43–45.*

Laboratory No.		Weight.	Water.	Protein.	Fat.	Carbohydrates.	Nitrogen.	Carbon.	Hydrogen.	Heat of combustion.
	Experiment No. 43.	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Calories.*
3316	Total, 4 days	882.9	727.6	51.1	30.0	48.6	8.17	79.28	11.74	897
	Average per day	220.7	181.9	12.8	7.5	12.1	2.04	19.82	2.94	224
	Experiment No. 44.									
3317	Total, 4 days	801.7	654.2	64.6	16.0	49.7	10.34	70.15	9.70	762
	Average per day	200.4	163.5	16.2	4.0	12.4	2.59	17.54	2.42	190
	Experiment No. 45.									
3320	Total, 1 day	257.5	214.5	13.7	7.7	14.9	2.19	22.22	3.24	256

Table 34 shows the composition and heat of combustion of the urine during this series. (For details, see Appendix, Tables 110 and 111.)

TABLE 34.—*Amount and composition of urine, metabolism experiments Nos. 43–45.*

Experiment No.	Date.	Amount.	Nitrogen.	Carbon.	Hydrogen.	Water.	Heat of combustion.
	1901.	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Calories.*
43	Mar. 29–30	1,686.1	18.69	13.60	3.61	1,618.7	150
	30–31	1,923.7	19.72	14.35	3.81	1,851.7	156
	31–Apr. 1	2,006.6	18.39	13.38	3.56	1,938.0	144
	Apr. 1–2	2,269.3	18.21	13.25	3.52	2,199.4	138
	Total, 4 days	7,885.7	75.01	54.58	14.50	7,607.8	588
44	Apr. 2–3	1,989.4	17.10	12.44	3.31	1,924.8	139
	3–4	2,081.6	16.10	11.71	3.11	2,019.3	137
	4–5	2,258.9	16.88	12.28	3.26	2,193.1	142
	5–6	1,912.6	17.58	12.79	3.40	1,847.0	142
	Total, 4 days	8,242.5	67.66	49.22	13.08	7,984.2	560
45	Apr. 6–7	2,233.9	18.86	13.72	3.64	2,162.3	150
43–45	Total, 9 days	18,362.1	161.53	117.52	31.22	17,754.3	1,298

Table 35 summarizes the record of carbon dioxid and water in the ventilating air current. (Details in Appendix, Tables 117–122.)

TABLE 35.—*Record of carbon dioxid and water in ventilating air current, metabolism experiments Nos. 43–45.*

Experiment No.	Date.	(*a*) Volume of air.	Carbon dioxid. (*b*) In incoming air.	(*c*) In outgoing air.	(*d*) Correction for amount remaining in chamber.	(*e*) Amount exhaled by subject, $c+d-b$.	(*f*) Total carbon in respiratory products, $e \times \frac{3}{11}$.	Water. (*g*) In incoming air.	(*h*) In outgoing air.	(*i*) Correction for amount remaining in chamber.	(*k*) Total water of respiration and perspiration, $h+i-g$.
	1901.	*Liters.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
43	Mar. 29–30 .	117,375	76.1	1,828.7	−0.2	1,752.4	477.9	84.3	1,302.7	+2,284.4	3,502.8
	30–31 .	118,930	71.3	1,719.7	+1.0	1,649.4	449.8	86.9	1,325.1	+1,958.2	3,196.4
	Mar. 31–Apr. 1 ...	115,044	66.1	1,692.7	−1.3	1,625.3	443.2	86.3	1,269.5	+1,922.9	3,106.1
	Apr. 1–2....	112,713	67.9	1,670.8	− .8	1,602.1	436.9	91.5	1,235.3	+1,842.5	2,986.3
	Total	464,062	281.4	6,911.9	−1.3	6,629.2	1,807.8	349.0	5,132.6	+8,008.0	12,791.6
44	Apr. 2–3....	112,713	65.9	1,869.2	+2.8	1,806.1	492.6	98.8	1,264.9	+2,007.0	3,173.1
	3–4....	112,713	67.6	1,860.1	−1.7	1,790.8	488.4	101.7	1,228.0	+1,908.5	3,034.8
	4–5....	116,598	68.3	1,917.3	+1.0	1,850.0	504.5	104.5	1,256.8	+1,945.4	3,097.7
	5–6....	117,376	71.3	2,028.1	−2.4	1,954.4	533.0	105.5	1,329.2	+2,351.6	3,575.3
	Total	459,400	273.1	7,674.7	− .3	7,401.3	2,018.5	410.5	5,078.9	+8,212.5	12,880.9
45	Apr. 6–7....	116,598	71.3	1,780.4	+ .8	1,709.9	466.3	107.0	1,302.1	+1,965.6	3,160.7

Table 36 summarizes the calorimetric determinations. (Details in Appendix, Tables 123 and 124.)

TABLE 36.—*Summary of calorimetric measurements, metabolism experiments Nos. 43–45.*

Experiment No.	Date.	(*a*) Heat carried away by water current.	(*b*) Correction for temperature of food and dishes and changes in temperature of calorimeter.	(*c*) Heat rendered latent in vaporization of water.	(*d*) Total heat determined, $a+b+c$.	(*e*) Heat equivalent of external muscular work.
	1901.	*Calories.*	*Calories.*	*Calories.*	*Calories.*	*Calories.*
43	Mar. 29–30	4,759.8	− 19.4	723.2	5,463.6	611.4
	30–31	4,520.1	− 13.4	737.2	5,243.9	522.5
	31–Apr. 1	4,445.7	− 63.8	698.0	5,079.9	553.0
	Apr. 1–2	4,399.2	− 44.5	676.8	5,031.5	503.2
	Total, 4 days	18,124.8	−141.1	2,835.2	20,818.9	2,190.1
44	Apr. 2–3	4,558.0	− 41.0	691.5	5,208.5	559.0
	3–4	4,446.5	− 58.3	665.3	5,053.5	539.3
	4–5	4,473.8	− 40.0	681.7	5,115.5	561.0
	5–6	4,729.1	− 37.7	725.4	5,416.8	624.4
	Total, 4 days	18,207.4	−177.0	2,763.9	20,794.3	2,283.7
45	Apr. 6–7	4,502.3	− 46.5	706.2	5,162.0	576.8

Balance of income and outgo of matter and energy.—From the preceding statistics the income and outgo of nitrogen, carbon, hydrogen, and energy on the different days of the experiments are computed, and the results are shown in Tables 37–40. Formulas in the column headings show how most of the results were derived. (See preceding tables of these experiments and Appendix, Tables 117–124 for details.)

TABLE 37.—*Income and outgo of nitrogen and carbon, metabolism experiments Nos. 43–45.*

Date.	Nitrogen.				Carbon.				
	(*a*) In food.	(*b*) In feces.	(*c*) In urine.*	(*d*) Gain(+) or loss (−), *a*−(*b*+*c*).	(*e*) In food.	(*f*) In feces.	(*g*) In urine.†	(*h*) In respiratory products.	(*i*) Gain(+) or loss (−), *e*−(*f*+*g*+*h*).
1901.									
Experiment No. 43.	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
Mar. 29–30	17.1	2.0	19.1	− 4.0	431.0	19.9	13.8	477.9	− 80.6
30–31	17.2	2.1	20.0	− 4.9	431.1	19.8	14.5	449.9	− 53.1
31–Apr. 1	17.1	2.0	18.8	− 3.7	431.1	19.8	13.5	443.3	− 45.5
Apr. 1–2	17.2	2.1	18.5	− 3.4	431.1	19.8	13.4	436.9	− 39.0
Total	68.6	8.2	76.4	−16.0	1,724.3	79.3	55.2	1,808.0	−218.2
Average, 1 day	17.1	2.0	19.1	− 4.0	431.1	19.8	13.8	452.0	− 54.6
Experiment No. 44.									
Apr. 2–3	17.7	2.5	17.5	− 2.3	491.8	17.6	12.6	492.6	− 31.0
3–4	17.8	2.6	16.4	− 1.2	491.9	17.5	11.8	488.4	− 25.8
4–5	17.7	2.6	17.3	− 2.2	491.8	17.6	12.5	504.5	− 42.8
5–6	17.8	2.6	17.9	− 2.7	491.9	17.5	12.9	533.0	− 71.5
Total	71.0	10.3	69.1	− 8.4	1,967.4	70.2	49.8	2,018.5	−171.1
Average, 1 day	17.8	2.6	17.3	− 2.1	491.8	17.5	12.5	504.6	− 42.8
Experiment No. 45.									
Apr. 6–7	17.4	2.2	19.3	− 4.1	436.2	22.2	13.8	466.3	− 66.1

* Nitrogen in perspiration included here. † Carbon in perspiration included here.

TABLE 38.—*Income and outgo of water and hydrogen, metabolism experiments Nos. 43–45.*

Date.	Water.					
	(*a*) In food.	(*b*) In drink.	(*c*) In feces.	(*d*) In urine.	(*e*) In respiratory products.	(*f*) Apparent loss, *a*+*b*−(*c*+*d*+*e*).
1901.						
Experiment No. 43.	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
Mar. 29–30	2,543.4	2,150	181.9	1,618.7	3,502.8	− 610.0
30–31	2,543.4	2,150	181.9	1,851.7	3,196.4	− 536.6
31–Apr. 1	2,543.4	2,150	181.9	1,938.0	3,106.1	− 532.6
Apr. 1–2	2,543.4	2,150	181.9	2,199.4	2,986.3	− 674.2
Total	10,173.6	8,600	727.6	7,607.8	12,791.6	−2,353.4
Average, 1 day	2,543.4	2,150	181.9	1,902.0	3,197.9	− 588.4
Experiment No. 44.						
Apr. 2–3	1,860.8	2,950	163.6	1,924.8	3,173.1	− 450.7
3–4	1,860.8	2,950	163.5	2,019.3	3,034.8	− 406.8
4–5	1,860.8	2,950	163.6	2,193.1	3,097.7	− 643.6
5–6	1,860.8	2,950	163.5	1,847.0	3,575.3	− 775.0
Total	7,443.2	11,800	654.2	7,984.2	12,880.9	−2,276.1
Average, 1 day	1,860.8	2,950	163.6	1,996.0	3,220.2	− 569.0
Experiment No. 45.						
Apr. 6–7	2,536.7	2,150	214.5	2,162.3	3,160.7	− 850.8

TABLE 38.—*Income and outgo of water and hydrogen, etc.*—Continued.

Date.	Hydrogen. (g) In food.	(h) In feces.	(i) In urine.	(k) Apparent gain, $g-(h+i)$.	(l) Loss from water, $f\div 9$.	(m) Total gain (+) or loss (−), $k+l$.
1901.						
Experiment No. 43.	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
Mar. 29–30	67.8	3.0	3.6	+ 61.2	− 67.8	− 6.6
30–31	67.7	2.9	3.8	+ 61.0	− 59.6	+ 1.4
31–Apr. 1	67.8	2.9	3.6	+ 61.3	− 59.2	+ 2.1
Apr. 1–2	67.7	2.9	3.5	+ 61.3	− 74.9	−13.6
Total	271.0	11.7	14.5	+244.8	−261.5	−16.7
Average, 1 day	67.7	2.9	3.6	+ 61.2	− 65.4	− 4.2
Experiment No. 44.						
Apr. 2–3	74.8	2.5	3.3	+ 69.0	− 50.1	+18.9
3–4	74.8	2.4	3.1	+ 69.3	− 45.2	+24.1
4–5	74.8	2.4	3.3	+ 69.1	− 71.5	− 2.4
5–6	74.8	2.4	3.4	+ 69.0	− 86.1	−17.1
Total	299.2	9.7	13.1	+276.4	−252.9	+23.5
Average, 1 day	74.8	2.4	3.3	+ 69.1	− 63.2	+ 5.9
Experiment No. 45.						
Apr. 6–7	67.9	3.2	3.6	+ 61.1	− 94.5	−33.4

TABLE 39.—*Gain or loss of protein ($N\times 6.25$), fat, and water, metabolism experiments Nos. 43–45.*

Date.	(a) Nitrogen gained (+) or lost (−).	(b) Protein gained (+) or lost (−), $a\times 6.25$.	(c) Total carbon gained (+) or lost (−).	(d) Carbon in protein gained (+) or lost (−), $b\times 0.53$.	(e) Carbon in fat, etc., gained (+) or lost (−), $c-d$.	(f) Fat gained (+) or lost (−), $e\div 0.7608$.
1901.						
Experiment No. 43.	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
Mar. 29–30	− 4.0	− 25.0	− 80.6	−13.2	− 67.4	− 88.6
30–31	− 4.9	− 30.6	− 53.1	−16.2	− 36.9	− 48.5
31–Apr. 1	− 3.7	− 23.1	− 45.5	−12.3	− 33.2	− 43.6
Apr. 1–2	− 3.4	− 21.3	− 39.0	−11.3	− 27.7	− 36.4
Total	−16.0	−100.0	−218.2	−53.0	−165.2	−217.1
Average, 1 day	− 4.0	− 25.0	− 54.5	−13.2	− 41.3	− 54.3
Experiment No. 44.						
Apr. 2–3	− 2.3	− 14.4	− 31.0	− 7.6	− 23.4	− 30.8
3–4	− 1.2	− 7.5	− 25.8	− 4.0	− 21.8	− 28.6
4–5	− 2.2	− 13.7	− 42.8	− 7.3	− 35.5	− 46.6
5–6	− 2.7	− 16.9	− 71.5	− 8.9	− 62.6	− 82.3
Total	− 8.4	− 52.5	−171.1	−27.8	−143.3	−188.3
Average, 1 day	− 2.1	− 13.1	− 42.8	− 7.0	− 35.8	− 47.1
Experiment No. 45.						
Apr. 6–7	− 4.1	− 25.6	− 66.1	−13.6	− 52.5	− 69.0

TABLE 39.—*Gain or loss of protein ($N\times 6.25$), fat, and water, etc.*—Continued.

Date.	(*g*) Total hydrogen gained (+) or lost (−).	(*h*) Hydrogen in protein gained (+) or lost (−), $b\times 0.07$.	(*i*) Hydrogen in fat gained (+) or lost (−), $f\times 0.118$.	(*k*) Hydrogen in water, etc., gained (+) or lost (−), $g-(h+i)$.	(*l*) Water gained (+) or lost (−), $k\times 9$.
1901.					
Experiment No. 43.	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
Mar. 29–30	− 6.6	−1.8	−10.5	+ 5.7	+ 51.3
30–31	+ 1.4	−2.1	− 5.7	+ 9.2	+ 82.8
31–Apr. 1	+ 2.1	−1.6	− 5.1	+ 8.8	+ 79.2
Apr. 1–2	−13.6	−1.5	− 4.3	− 7.8	− 70.2
Total	−16.7	−7.0	−25.6	+15.9	+143.1
Average, 1 day	− 4.2	−1.7	− 6.4	+ 4.0	+ 35.8
Experiment No. 44.					
Apr. 2–3	+18.9	−1.0	− 3.6	+23.5	+211.5
3–4	+24.1	− .5	− 3.4	+28.0	+252.0
4–5	− 2.4	−1.0	− 5.5	+ 4.1	+ 36.9
5–6	−17.1	−1.2	− 9.7	− 6.2	− 55.8
Total	+23.5	−3.7	−22.2	+49.4	+444.6
Average, 1 day	+ 5.9	− .9	− 5.6	+12.4	+111.2
Experiment No. 45.					
Apr. 6–7	−33.4	−1.8	− 8.1	−23.5	−211.5

TABLE 40.—*Income and outgo of energy, metabolism experiments Nos. 43–45.*

Date.	(*a*) Heat of combustion of food eaten.	(*b*) Heat of combustion of feces.	(*c*) Heat of combustion of urine.	(*d*) Estimated heat of combustion of protein gained (+) or lost (−).	(*e*) Estimated heat of combustion of fat gained (+) or lost (−).	(*f*) Estimated energy of material oxidized in the body, $a-(b+c+d+e)$.	(*g*) Heat determined.	(*h*) Heat determined greater (+) or less (−) than estimated, $f-g$.	(*i*) Heat determined greater (+) or less (−) than estimated, $h\div f$.
1901.									
Experiment No. 43.	*Calories.*	*Calories.*	*Calories.*	*Calories.*	*Calories.*	*Calories.*	*Calories.*	*Calories.*	*Per cent.*
Mar. 29–30	4,867	225	150	−141	− 845	5,478	5,463	− 15	−0.2
30–31	4,867	224	156	−173	− 463	5,123	5,244	+121	+2.3
31–Apr. 1	4,867	224	144	−131	− 416	5,046	5,080	+ 34	+ .7
Apr. 1–2	4,867	224	138	−120	− 347	4,972	5,032	+ 60	+1.2
Total	19,468	897	588	−565	−2,071	20,619	20,819	+200	....
Average, 1 day	4,867	224	147	−141	− 518	5,155	5,205	+ 50	+1.0
Experiment No. 44.									
Apr. 2–3	4,932	190	139	− 81	− 294	4,978	5,208	+230	+4.6
3–4	4,932	191	137	− 42	− 273	4,919	5,054	+135	+2.7
4–5	4,932	190	142	− 78	− 445	5,123	5,115	− 8	− .2
5–6	4,932	191	142	− 96	− 785	5,480	5,417	− 63	−1.2
Total	19,728	762	560	−297	−1,797	20,500	20,794	+294	....
Average, 1 day	4,932	190	140	− 74	− 449	5,125	5,198	+ 73	+1.4
Experiment No. 45.									
Apr. 6–7	4,860	256	150	−145	− 658	5,257	5,162	− 95	−1.8

METABOLISM EXPERIMENTS NOS. 46–48.

This series of experiments was intended to be, as nearly as possible, an exact duplicate of the preceding. The preliminary period began with breakfast on April 29, 1901, and continued the usual four days. The diet during this period was the same as that planned for experiment No. 46, and for exercise the subject walked and rode a bicycle daily. He was in excellent health and spirits and relished the food selected.

On the evening of May 2 he entered the calorimeter and, after arranging the contents of the chamber, retired at the usual time, 11 o'clock. The experiment proper (No. 46) began at 7 a. m. May 3 and lasted four days. The programme was the same as outlined before (page 45), the total muscular work done being considerable. The diet consisted of a basal ration, furnishing about 45.5 grams of protein and 1,809 calories of energy, which was supplemented by sufficient milk and butter to bring the total protein and energy up to 103 grams and 4,836 calories, respectively, the greater part of the energy being supplied by fat. The food was relished and the subject felt in excellent condition.

On May 7, at 7 a. m., experiment No. 46 ended and experiment No. 47 began. This was of the usual length (four days), with a diet consisting largely of carbohydrates, which was made up of the same basal ration as before, with sufficient additional food, mainly cane sugar and milk sugar, to bring the total protein and energy furnished up to 102.2 grams and 4,710 calories, respectively. The sudden change in the character of the food had no unpleasant effect and the carbohydrate diet was relished even more than the large amount of butter fat. The daily programme and the amount of work was the same as in the previous work experiments. The subject slept well at night and was not tired at the conclusion of the experiment.

At 7 a. m. on May 11 the subject returned to a fat diet and experiment No. 48 began, and lasted one day. The ration was the same as that in experiment No. 46, with the exception of an increase of 20 calories in its energy value. The sudden change was not entirely agreeable to the subject and he did not relish the food as well as the preceding ration. He was more restless at night than before, but felt perfectly well when he left the calorimeter at 7 a. m. on May 12.

In experiments Nos. 46 and 48 it will be seen that the fats furnished about 60 per cent of the total energy, while in experiment No. 47 the carbohydrates furnished over 73 per cent.

Statistics of income and outgo.—The statistics of income and outgo of matter and energy are given in Tables 41–45.

The amounts, composition, and heats of combustion of the food materials used in this series are shown in Table 41, and the outgo of matter and energy in the feces is shown in Table 42.

TABLE 41.—*Weight, composition, and heat of combustion of food, metabolism experiments Nos. 46–48.*

Laboratory No.	Food material.	Weight per day.	Water.	Protein.	Fat.	Carbohydrates.	Nitrogen.	Carbon.	Hydrogen.	Heat of combustion.
	Basal ration.	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Calories.*
3340	Beef	35	21.7	11.8	1.0	....	1.89	6.84	1.02	77
3341	Butter	20	1.7	.2	17.5	....	.04	13.14	1.53	162
3346	Bread	350	149.1	25.2	5.6	166.9	4.45	91.28	12.88	916
3305	Ginger snaps	60	2.4	3.6	3.4	49.2	.63	25.74	3.98	259
3347	Shredded wheat	40	3.2	4.0	.5	31.8	.70	16.58	2.56	162
	Sugar	45	....	....	....	45.0	....	18.95	2.92	178
3348	Cereal coffee	1,200	1,186.8	.7	....	12.0	.12	5.64	.84	55
	Total	1,750	1,364.9	45.5	28.0	304.9	7.83	178.17	25.73	1,809
	Supplemental ration.									
	EXPERIMENT NO. 46.									
3343	Whole milk	1,405	1,201.3	54.8	77.3	61.8	8.71	108.04	16.86	1,208
3341	Butter	225	19.4	2.7	196.7	....	.45	147.82	17.26	1,819
	Total ration per day	3,380	2,585.6	103.0	302.0	366.7	16.99	434.03	59.85	4,836
	EXPERIMENT NO. 47.									
3344	Whole milk	500	426.0	19.5	25.0	26.0	3.10	39.30	6.05	441
3340	Beef	25	15.5	8.4	.7	....	1.35	4.88	.73	55
3346	Bread	200	85.2	14.4	3.2	95.4	2.54	52.16	7.36	524
3347	Shredded wheat	40	3.2	4.0	.5	31.8	.70	16.58	2.56	162
3303	Graham crackers	100	2.7	8.9	10.9	74.6	1.56	45.37	6.69	467
3305	Ginger snaps	25	1.0	1.5	1.4	20.5	.26	10.72	1.66	108
3258	Milk sugar	100	5.1	....	....	94.9	....	40.00	6.15	372
	Cane sugar	195	....	....	....	195.0	....	82.09	12.64	772
	Total ration per day	2,935	1,903.6	102.2	69.7	843.1	17.34	469.27	69.57	4,710
	EXPERIMENT NO. 48.									
3345	Whole milk	1,405	1,197.0	54.8	67.4	75.9	8.71	119.42	16.44	1,228
3341	Butter	225	19.4	2.7	196.7	....	.45	147.82	17.26	1,819
	Total ration per day	3,380	2,581.3	103.0	292.1	380.8	16.99	445.41	59.43	4,856

TABLE 42.—*Weight, composition, and heat of combustion of feces, metabolism experiments Nos. 46–48.*

Laboratory No.		Weight.	Water.	Protein.	Fat.	Carbohydrates.	Nitrogen.	Carbon.	Hydrogen.	Heat of combustion.
	Experiment No. 46.	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Calories.*
3350	Total, 4 days	868.1	724.0	44.8	43.4	32.1	7.17	75.53	10.68	858
	Average per day	217.0	181.0	11.2	10.9	8.0	1.79	18.88	2.67	214
	Experiment No. 47.									
3351	Total, 4 days	893.6	739.0	66.8	14.3	56.3	10.68	74.62	10.37	795
	Average per day	223.4	184.8	16.7	3.6	14.1	2.67	18.65	2.59	199
	Experiment No. 48.									
3352	Total	239.3	192.6	12.3	13.4	13.2	1.97	24.26	3.52	280

Table 43 gives a summary of the quantity, composition, and heat of combustion of the urine in experiments Nos. 46–48. (Details in Tables 113 and 114 of Appendix.)

TABLE 43.—*Amount and composition of urine, metabolism experiments Nos. 46–48.*

Experiment No.	Date.	Amount.	Nitrogen.	Carbon.	Hydrogen.	Water.	Heat of combustion.
	1901.	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Calories.*
46	May 3–4	1,342.8	14.13	10.87	3.11	1,285.4	152
	4–5	1,246.1	16.24	12.50	3.57	1,182.0	133
	5–6	1,247.6	16.46	12.67	3.62	1,182.7	157
	6–7	1,610.1	16.73	12.87	3.68	1,542.1	134
	Total, 4 days	5,446.6	63.56	48.91	13.98	5,192.2	576
47	May 7–8	1,639.3	15.85	12.20	3.48	1,574.1	134
	8–9	1,586.3	15.75	12.12	3.46	1,521.8	152
	9–10	1,737.7	16.01	12.32	3.52	1,671.3	151
	10–11	1,462.6	16.72	12.86	3.68	1,395.5	142
	Total, 4 days	6,425.9	64.33	49.50	14.14	6,162.7	579
48	May 11–12	1,417.9	17.19	13.23	3.78	1,349.4	162
46–48	Total, 9 days	13,290.4	145.08	111.64	31.90	12,704.3	1,317

Table 44 summarizes the determinations of water and carbon dioxid, and Table No. 45 gives the summary of the amounts of heat given off during this series of experiments. (See Tables 117–122 in Appendix for details.

TABLE 44.—*Record of carbon dioxid and water in ventilating air current, metabolism experiments Nos. 46–48.*

Experiment No.	Date.	(*a*) Volume of air.	Carbon dioxid. (*b*) In incoming air.	(*c*) In outgoing air.	(*d*) Correction for amount remaining in chamber.	(*e*) Amount exhaled by subject, *c+d−b*.	(*f*) Total carbon in respiratory products, $e \times \frac{3}{11}$.	Water. (*g*) In incoming air.	(*h*) In outgoing air.	(*i*) Correction for amount remaining in chamber.	(*k*) Total water of respiration and perspiration, *h+i−g*.
	1901.	*Liters.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
46	May 3–4	111,159	70.8	1,850.9	−3.5	1,776.0	484.4	91.5	1,541.9	+2,676.1	4,126.5
	4–5	109,605	79.3	1,749.8	− .4	1,670.1	455.5	91.0	1,533.9	+2,373.9	3,816.8
	5–6	110,382	77.0	1,738.4	−1.7	1,659.7	452.6	89.8	1,503.4	+2,342.0	3,755.6
	6–7	109,605	74.5	1,718.0	+1.5	1,645.0	448.7	89.1	1,496.6	+2,173.4	3,580.9
	Total, 4 days	440,751	301.6	7,057.1	−4.1	6,751.4	1,841.2	361.4	6,075.8	+9,565.4	15,279.8
47	May 7–8	109,605	79.9	1,890.1	+2.0	1,812.2	494.2	95.6	1,488.8	+2,390.1	3,783.3
	8–9	109,605	80.6	1,908.2	− .9	1,826.7	498.2	96.9	1,500.7	+2,315.9	3,719.7
	9–10	110,382	102.4	1,942.1	− .6	1,839.1	501.6	104.5	1,552.0	+2,323.9	3,771.4
	10–11	111,159	102.6	2,004.8	+1.3	1,903.5	519.1	109.4	1,582.8	+2,550.6	4,024.0
	Total, 4 days	440,751	365.5	7,745.2	+1.8	7,381.5	2,013.1	406.4	6,124.3	+9,580.5	15,298.4
48	May 11–12	109,605	80.6	1,839.5	−1.0	1,757.9	479.4	104.9	1,594.0	+2,311.4	3,800.5

TABLE 45.—*Summary of calorimetric measurements, metabolism experiments Nos. 46–48.*

Experiment No.	Date.	(a) Heat carried away by water current.	(b) Correction for temperature of food and dishes and changes in temperature of calorimeter.	(c) Heat rendered latent in vaporization of water.	(d) Total heat determined, $a+b+c$.	(e) Heat equivalent of external muscular work.
	1901.	*Calories.*	*Calories.*	*Calories.*	*Calories.*	*Calories.*
46	May 3–4	4,738.4	− 71.6	860.1	5,526.9	594.5
	4–5	4,437.5	− 94.4	854.3	5,197.4	541.3
	5–6	4,390.8	− 69.9	834.6	5,155.5	535.7
	6–7	4,301.7	− 65.6	834.3	5,070.4	533.6
	Total, 4 days	17,868.4	−301.5	3,383.3	20,950.2	2,205.1
47	May 7–8	4,455.5	− 69.0	824.7	5,211.2	571.8
	8–9	4,396.9	− 59.4	830.5	5,168.0	551.2
	9–10	4,443.9	− 64.6	856.3	5,235.6	546.5
	10–11	4,565.7	− 61.6	874.0	5,378.1	578.8
	Total, 4 days	17,862.0	−254.6	3,385.5	20,992.9	2,248.3
48	May 11–12	4,426.3	− 90.0	881.7	5,218.0	550.0

Balance of income and outgo of matter and energy.—Tables 46–49 show the summarized values for the income and outgo of nitrogen, carbon, hydrogen, and energy as computed from the details found in the preceding tables and in the Appendix, Tables 117–124.

TABLE 46.—*Income and outgo of nitrogen and carbon, metabolism experiments Nos. 46–48.*

Date.	Nitrogen. (a) In food.	(b) In feces.	(c) In urine.*	(d) Gain(+) or loss(−), $a-(b+c)$	Carbon. (e) In food.	(f) In feces.	(g) In urine.*	(h) In respiratory products.	(i) Gain (+) or loss (−), $e-(f+g+h)$
1901.									
Experiment No. 46.	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
May 3–4	17.0	1.8	14.4	+ .8	434.1	18.8	11.0	484.4	− 80.1
4–5	17.0	1.8	16.4	−1.2	434.0	18.9	12.6	455.5	− 53.0
5–6	17.0	1.8	16.7	−1.5	434.0	18.9	12.8	452.6	− 50.3
6–7	17.0	1.8	16.9	−1.7	434.0	18.9	12.9	448.7	− 46.5
Total	68.0	7.2	64.4	−3.6	1,736.1	75.5	49.3	1,841.2	−229.9
Average, 1 day	17.0	1.8	16.1	− .9	434.0	18.9	12.3	460.3	− 57.5
Experiment No. 47.									
May 7–8	17.3	2.6	16.0	−1.3	469.2	18.7	12.3	494.2	− 56.0
8–9	17.4	2.7	16.0	−1.3	469.3	18.6	12.2	498.2	− 59.7
9–10	17.3	2.7	16.3	−1.7	469.3	18.7	12.4	501.6	− 63.4
10–11	17.4	2.7	16.9	−2.2	469.3	18.6	13.0	519.1	− 81.4
Total	69.4	10.7	65.2	−6.5	1,877.1	74.6	49.9	2,013.1	−260.5
Average, 1 day	17.4	2.7	16.3	−1.6	469.3	18.7	12.5	503.3	− 65.1
Experiment No. 48.									
May 11–12	17.0	2.0	17.4	−2.4	445.4	24.3	13.3	479.4	− 71.6

*The perspiration for the 9 days of experiments Nos. 46–48 contained 2.0 grams of nitrogen, equivalent to 4.3 grams of urea, which would contain 0.9 gram of carbon. This nitrogen and carbon have been added to those of urine here.

TABLE 47.—*Income and outgo of water and hydrogen, metabolism experiments Nos. 46–48.*

Date.	Water. (a) In food.	(b) In drink.	(c) In feces.	(d) In urine.	(e) In respiratory products.	(f) Apparent loss, $a+b-(c+d+e)$.
1901.						
Experiment No. 46.	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
May 3–4	2,585.6	2,150	181.0	1,285.4	4,126.5	− 857.3
4–5	2,585.6	2,150	181.0	1,182.0	3,816.8	− 444.2
5–6	2,585.6	2,150	181.0	1,182.7	3,755.6	− 383.7
6–7	2,585.6	2,150	181.0	1,542.1	3,580.9	− 568.4
Total	10,342.4	8,600	724.0	5,192.2	15,279.8	−2,253.6
Average, 1 day	2,585.6	2,150	181.0	1,298.0	3,820.0	− 563.4
Experiment No. 47.						
May 7– 8	1,903.6	2,950	184.7	1,574.1	3,783.3	− 688.5
8– 9	1,903.6	2,950	184.8	1,521.8	3,719.7	− 572.7
9–10	1,903.6	2,950	184.7	1,671.3	3,771.4	− 773.8
10–11	1,903.6	2,950	184.8	1,395.5	4,024.0	− 750.7
Total	7,614.4	11,800	739.0	6,162.7	15,298.4	−2,785.7
Average, 1 day	1,903.6	2,950	184.7	1,540.7	3,824.6	− 696.4
Experiment No. 48.						
May 11–12	2,581.3	2,150	192.6	1,349.4	3,800.5	− 611.2

Date.	Hydrogen. (g) In food.	(h) In feces.	(i) In urine.	(k) Apparent gain, $g-(h+i)$.	(l) Loss from water, $f \div 9$.	(m) Total gain (+) or loss (−), $k+l$.
1901.						
Experiment No. 46.	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
May 3–4	59.8	2.7	3.1	+ 54.0	− 95.3	−41.3
4–5	59.9	2.6	3.6	+ 53.7	− 49.3	+ 4.4
5–6	59.8	2.7	3.6	+ 53.5	− 42.6	+10.9
6–7	59.9	2.7	3.7	+ 53.5	− 63.2	− 9.7
Total	239.4	10.7	14.0	+214.7	−250.4	−35.7
Average, 1 day	59.9	2.7	3.5	+ 53.7	− 62.6	− 8.9
Experiment No. 47.						
May 7– 8	69.5	2.6	3.5	+ 63.4	− 76.5	−13.1
8– 9	69.6	2.6	3.5	+ 63.5	− 63.6	− .1
9–10	69.6	2.6	3.5	+ 63.5	− 86.0	−22.5
10–11	69.6	2.6	3.7	+ 63.3	− 83.4	−20.1
Total	278.3	10.4	14.2	+253.7	−309.5	−55.8
Average, 1 day	69.6	2.6	3.5	+ 63.4	− 77.4	−14.0
Experiment No. 48.						
May 11–12	59.4	3.5	3.8	+ 52.1	− 67.9	−15.8

TABLE 48.—*Gain or loss of protein ($N \times 6.25$), fat, and water, metabolism experiments Nos. 46–48.*

Date.	(*a*) Nitrogen gained (+) or lost (−).	(*b*) Protein gained (+) or lost (−), $a \times 6.25$.	(*c*) Total carbon gained (+) or lost (−).	(*d*) Carbon in protein gained (+) or lost (−), $b \times 0.53$.	(*e*) Carbon in fat, etc., gained (+) or lost (−), $c-d$.	(*f*) Fat gained (+) or lost (−), $e \div 0.7608$.
1901.						
Experiment No. 46.	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
May 3–4	+0.8	+ 5.0	− 80.1	+ 2.7	− 82.8	−108.8
4–5	−1.2	− 7.5	− 53.0	− 4.0	− 49.0	− 64.4
5–6	−1.5	− 9.4	− 50.3	− 5.0	− 45.3	− 59.5
6–7	−1.7	−10.6	− 46.5	− 5.6	− 40.9	− 53.8
Total	−3.6	−22.5	−229.9	−11.9	−218.0	−286.5
Average, 1 day	− .9	− 5.6	− 57.5	− 3.0	− 54.5	− 71.6
Experiment No. 47.						
May 7– 8	−1.3	− 8.1	− 56.0	− 4.3	− 21.7	− 68.0
8– 9	−1.3	− 8.1	− 59.7	− 4.3	− 55.4	− 72.8
9–10	−1.7	−10.6	− 63.4	− 5.6	− 57.8	− 76.0
10–11	−2.2	−13.8	− 81.4	− 7.3	− 74.1	− 97.4
Total	−6.5	−40.6	−260.5	−21.5	−239.0	−314.2
Average, 1 day	−1.6	−10.1	− 65.1	− 5.4	− 59.7	− 78.5
Experiment No. 48.						
May 11–12	−2.4	−15.0	− 71.6	− 8.0	− 63.6	− 83.6

Date.	(*g*) Total hydrogen gained (+) or lost (−).	(*h*) Hydrogen in protein gained (+) or lost (−), $b \times 0.07$.	(*i*) Hydrogen in fat gained (+) or lost (−), $f \times 0.118$.	(*k*) Hydrogen in water, etc., gained (+) or lost (−), $g-(h+i)$.	(*l*) Water gained (+) or lost (−), $k \times 9$.
1901.					
Experiment No. 46.	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
May 3–4	−41.3	+0.3	−12.9	−28.7	−258.3
4–5	+ 4.4	− .5	− 7.6	+12.5	+112.5
5–6	+10.9	− .7	− 7.0	+18.6	+167.4
6–7	− 9.7	− .7	− 6.3	− 2.7	− 24.3
Total	−35.7	−1.6	−33.8	− .3	− 2.7
Average, 1 day	− 8.9	− .4	− 8.4	− .1	− .7
Experiment No. 47.					
May 7– 8	−13.1	− .6	− 8.0	− 4.5	− 40.5
8– 9	− .1	− .6	− 8.6	+ 9.1	+ 81.9
9–10	−22.5	− .7	− 9.0	−12.8	−115.2
10–11	−20.1	− .9	−11.5	− 7.7	− 69.3
Total	−55.8	−2.8	−37.1	−15.9	−143.1
Average, 1 day	−14.0	− .7	− 9.3	− 4.0	− 35.8
Experiment No. 48.					
May 11–12	−15.8	−1.0	− 9.9	− 4.9	− 44.1

TABLE 49.—*Income and outgo of energy, metabolism experiments Nos. 46–48.*

Date.	(a) Heat of combustion of food eaten.	(b) Heat of combustion of feces.	(c) Heat of combustion of urine.	(d) Estimated heat of combustion of protein gained (+) or lost (−).	(e) Estimated heat of combustion of fat gained (+) or lost (−).	(f) Estimated energy of material oxidized in the body, $a-(b+c+d+e)$.	(g) Heat determined.	(h) Heat determined greater (+) or less (−) than estimated, $f-g$.	(i) Heat determined greater (+) or less (−) than estimated, $h \div f$.
1901.									
Experiment No. 46.	*Calories.*	*Calories.*	*Calories.*	*Calories.*	*Calories.*	*Calories.*	*Calories.*	*Calories.*	*Per cent.*
May 3–4	4,836	215	152	+ 28	−1,038	5,479	5,527	+ 48	+0.9
4–5	4,836	214	133	− 42	− 615	5,146	5,197	+ 49	+1.0
5–6	4,836	215	157	− 53	− 568	5,085	5,156	+ 71	+1.3
6–7	4,836	214	134	− 60	− 513	5,061	5,070	+ 9	+ .2
Total	19,344	858	576	−127	−2,734	20,771	20,950	+179	....
Avg., 1 day	4,836	214	144	− 32	− 683	5,193	5,238	+ 45	+ .8
Experiment No. 47.									
May 7–8	4,710	198	134	− 46	− 648	5,072	5,211	+139	+2.7
8–9	4,710	199	152	− 46	− 695	5,100	5,168	+ 68	+1.3
9–10	4,710	199	151	− 60	− 725	5,145	5,236	+ 91	+1.8
10–11	4,710	199	142	− 78	− 929	5,376	5,378	+ 2	0.0
Total	18,840	795	579	−230	−2,997	20,693	20,993	+300	....
Avg., 1 day	4,710	199	145	− 58	− 749	5,173	5,248	+ 75	+1.4
Experiment No. 48.									
May 11–12	4,856	280	162	− 85	− 798	5,297	5,218	− 79	−1.5

METABOLISM EXPERIMENTS NOS. 49–51.

As originally planned, the series of experiments beginning with No. 49 was to be similar as regards the diet and the amount of work to the preceding series, except that the order was to be reversed and the experiments were each to be of three days' duration. That is to say, the preliminary period and the first experiment of this series (No. 49) were to be with carbohydrates, the second experiment (No. 50) with fats, and the third experiment (No. 51) with carbohydrates again. This plan was carried out only so far as the preliminary period and the first experiment. A change in diet was then found necessary, as explained below.

The preliminary digestion experiment began with breakfast on March 23, 1902, and continued for four days, as usual. The subject entered the chamber on the evening of March 26 and retired at the usual time. Experiment No. 49 began at 7 a. m. on March 27 and lasted until 7 a. m. March 30. The diet during these two periods furnished 110.8 grams of protein and 5,499 calories of energy, more than 72 per cent of the energy being furnished by carbohydrates.

Experiment No. 50 was begun with the fat diet as planned, but in the afternoon of the first day (March 30) it was found necessary to change the plans and to terminate this experiment. At 2.15 p. m., or 15 minutes after beginning the afternoon's work, the subject telephoned that he could not eat all his dinner, as he had too much butter. In

fact, the 90 grams sent in for breakfast had been eaten in small portions during the morning, and it was not all consumed until 10.15 a. m. At noon he wanted the butter melted in order to eat it, and the quantity was so large that he became nauseated and could not eat either the butter or much of the other food. He was allowed to work until 3 p. m., when he was told to stop, change his underclothing, and lie down. He was given about 300 grams of hot beef tea, and it was planned to have him fast and to make this test rather longer than usual. The rectal thermometer[a] devised in connection with these investigations, and which has been found to give a very accurate and continuous record of body temperature, was connected with the recording devices and inserted. After stopping work and lying down the subject complained of a slight headache, but when he had drunk the beef tea he felt much better. At 7 a. m. of April 1, when experiment No. 51 began, beef tea was again offered the subject, but he did not want it at that time. At noon, however, he drank about 270 grams and at 6.30 p. m. 300 grams. He felt fairly well, but thought he would feel better if he sat up and read or studied.

To avoid the introduction of proteid material a well-known brand of extract of beef, which contains nitrogenous extractives, but practically no true proteids, was selected for making the beef tea. For purposes of analyses two samples, each of 25 centimeters, of the solution were placed in Kjeldahl flasks to be digested and then later aliquoted for the determination of nitrogen.

As a result of this necessary change in the diet, experiment No. 50 continued one day only, beginning at 7 a. m. March 30. The work was limited to five hours with the stationary bicycle. As has been stated before, the diet was insufficient, owing to the inability of the subject to eat the butter. The total amounts of protein and energy supplied were 65.2 grams and 2,601 calories, respectively.

Experiment No. 51, a fasting and rest experiment of two days duration, began at 7 a. m. on March 31 and continued until 7 a. m. April 2. During this period the subject had no food or drink excepting beef tea and water. The former furnished nitrogen corresponding to about 2 grams of protein (though with very little proteids) and 10 calories of energy per day. He moved about very little and reclined on the bed most of the time. When the subject left the calorimeter at 7 a. m. on the morning of April 3 he felt very well indeed, though he had been without food not merely the two days of experiment No. 51, but from 2 p. m. March 30 to 7 a. m. April 2, making all told a fast of 66 hours. On this account the experiment is of unusual interest.

On March 30 (during experiment No. 50), at about 1.30 p. m., the upper section of the inner thermal junction system of the calorimeter got out of order. This had happened also the previous night, sometime during the period from about 6.15 p. m. to 4 a. m. Rather than stop

[a] Arch. Physiol. [Pflüger], 88 (1901), p. 492.

the experiment it was decided to keep the top, lower, and bottom sections of the thermal junctions as near zero as possible and run the risk of a loss of heat through the metal walls as regards the upper section. During the night this procedure obviously would not involve much error, for the lower elimination of heat inside the apparatus during the resting and sleeping periods would not necessitate, as a rule, much heating or cooling of the zinc wall to keep it at the same temperature as the copper wall and thus prevent any heat from escaping from the calorimeter through the walls. But happening, as it did in the second instance, in the afternoon and during a work experiment, it became a matter of some importance. In about half an hour, however, the defective section of the junction system began again to give correct readings.

Statistics of income and outgo.—The tables following, Nos. 50–52, contain the data of income and outgo of matter and energy in this series of experiments.

The tables following show the amounts, composition, and heat of combustion of the nutrients used and the amounts and heat of combustion of those rejected in the feces during this series of experiments. (See Appendix, Tables 109 and 110, for analyses.)

TABLE 50.—*Weight, composition, and heat of combustion of foods, metabolism experiments Nos. 49–51.*

Laboratory No.	Food material.	Weight per day.	Water.	Protein.	Fat.	Carbohydrates.	Nitrogen.	Carbon.	Hydrogen.	Heat of combustion.
	Experiment No. 49.	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Calories.*
3418	Butter	20	1.8	.3	17.5	....	.04	13.01	2.08	161
3424	Milk	1,000	850.0	41.0	50.0	52.0	6.50	80.90	12.00	906
3419	Bread	550	228.8	47.3	9.9	256.9	8.25	143.83	21.12	1,454
3420	Ginger snaps	85	4.7	5.3	5.4	67.0	.92	36.23	5.41	362
3421	Shredded wheat	80	6.4	8.4	1.0	62.6	1.47	32.69	4.74	320
3422	Graham crackers	100	3.2	7.8	11.6	74.7	1.37	44.90	6.82	460
3258	Milk sugar	100	5.1	....	....	94.9	....	40.00	6.15	372
	Sugar	360	....	....	....	360.0	....	151.56	23.33	1,426
3425	Cereal coffee	1,200	1,191.6	.7	....	7.2	.12	3.56	.50	38
	Total, 1 day	3,495	2,291.6	110.8	95.4	975.3	18.67	546.68	82.15	5,499
	Experiment No. 50.									
3418	Butter	94.6	8.5	1.3	82.9	....	.21	61.52	9.84	763
3424	Milk	925.0	786.3	37.9	46.3	48.1	6.01	74.83	11.10	838
3419	Bread	220.0	91.5	18.9	4.0	102.7	3.30	57.53	8.45	581
3420	Ginger snaps	60.0	3.3	3.7	3.8	47.3	.65	25.57	3.82	256
3421	Shredded wheat	13.0	1.0	1.4	.2	10.2	.24	5.31	.77	52
	Sugar	22.8	....	....	....	22.8	....	9.60	1.48	90
3425	Cereal coffee	400.0	397.2	.2	....	2.4	.04	1.19	.17	13
	Beef tea [a]	294.2	291.6	1.8	....	....	.62	.71	.15	8
	Total, 1 day	2,029.6	1,579.4	65.2	137.2	233.5	11.07	236.26	35.78	2,601
	Experiment No. 51.									
	Beef tea	268.8	267.2	1.1	....	....	.35	.40	.08	5
	Do	300.0	297.3	1.8	....	....	.63	.72	.15	8
	Total, 1 day	568.8	564.5	2.9	....	....	.98	1.12	.23	13

[a] Used only on last day of experiment.

TABLE 51.—*Weight, composition, and heat of combustion of feces, metabolism experiments Nos. 49–50.*

Laboratory No.		Weight.	Water.	Protein.	Fat.	Carbohydrates.	Nitrogen.	Carbon.	Hydrogen.	Heat of combustion.
	Experiment No. 49.	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Calories.*
3428	Feces for 3 days..	615.6	510.3	39.2	12.9	36.9	6.27	49.62	6.83	516
	Average, 1 day ...	205.2	170.1	13.1	4.3	12.3	2.09	16.54	2.28	172
	Experiment No. 50.									
3429	Feces for 1 day ...	114.8	92.4	7.4	4.2	6.9	1.18	11.13	1.63	128

The following table gives the summarized determinations of amounts, composition, and heat of combustion of the urine. (See Appendix, Tables 113 and 114, for details.)

TABLE 52.—*Amount and composition of urine, metabolism experiments Nos. 49–51.*

Experiment No.	Date.	Amount.	Nitrogen.	Carbon.	Hydrogen.	Water.	Heat of combustion.
	1902.	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Calories.*
49	Mar. 27–28	2,018.8	15.42	12.20	3.43	1,954.15	135
	28–29	2,271.7	15.79	12.49	3.51	2,204.35	134
	29–30	2,715.9	15.16	11.99	3.37	2,648.25	136
	Total, 3 days	7,006.4	46.37	36.68	10.31	6,806.75	405
50	Mar. 30–31	1,681.7	13.51	10.68	3.01	1,625.55	118
51	Mar. 31–Apr. 1	1,017.4	11.73	9.28	2.61	971.12	97
	Apr. 1–2	778.1	13.23	10.46	2.94	727.98	107
	Total, 2 days	1,795.5	24.96	19.74	5.55	1,699.10	204
49–51	Total, 6 days	10,483.6	84.84	67.10	18.87	10,131.40	727

Table 53 shows the determinations of carbon dioxid and water in the ventilating air current, and Table 54 the heat measured, as summarized from Tables 117–122 in the Appendix.

TABLE 53.—*Record of carbon dioxid and water in ventilating air current, metabolism experiments Nos. 49–51.*

Experiment No.	Date.	(a) Volume of air.	Carbon dioxid. (b) In incoming air.	(c) In outgoing air.	(d) Correction for amount remaining in chamber.	(e) Amount exhaled by subject, $c+d-b$.	(f) Total carbon in respiratory products, $e \times \frac{3}{11}$.	Water. (g) In incoming air.	(h) In outgoing air.	(i) Correction for amount remaining in chamber.	(k) Total water of respiration and perspiration, $h+i-g$.
	1902.	*Liters.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
49	Mar. 27–28	114,268	61.5	2,013.2	+3.8	1,955.5	533.3	71.2	1,316.0	+2,269.2	3,514.0
	28–29	113,490	65.0	1,892.6	− .7	1,826.9	498.3	79.9	1,264.2	+1,875.9	3,060.2
	29–30	110,382	58.8	1,875.6	+1.2	1,818.0	495.8	83.4	1,233.3	+1,881.0	3,030.9
	Total, 3 days	338,140	185.3	5,781.4	+4.3	5,600.4	1,527.4	234.5	3,813.5	+6,026.1	9,605.1
50	Mar. 30–31	114,267	61.9	1,440.8	−4.3	1,374.6	374.9	77.9	1,211.1	+1,099.0	2,232.2
51	Mar. 31–Apr. 1	114,267	61.2	764.8	− .8	702.8	191.7	67.8	1,102.3	− 16.5	1,018.0
	Apr. 1–2	115,044	60.3	758.8	− .5	698.0	190.3	67.0	1,037.0	− 74.7	895.3
	Total, 2 days	229,311	121.5	1,523.6	−1.3	1,400.8	382.0	134.8	2,139.3	− 91.2	1,913.3

TABLE 54.—*Summary of calorimetric measurements, metabolism experiments Nos. 49–51.*

Experiment No.	Date.	(a) Heat carried away by water current.	(b) Correction for temperature of food and dishes and changes in temperature of calorimeter.	(c) Heat rendered latent in vaporization of water.	(d) Total heat determined, $a+b+c$.	(e) Heat equivalent of external muscular work.
	1902.	*Calories.*	*Calories.*	*Calories.*	*Calories.*	*Calories.*
49	Mar. 27–28	4,861.4	−115.3	748.4	5,494.5	559.6
	28–29	4,552.8	− 89.1	700.6	5,164.3	489.0
	29–30	4,498.8	−102.8	680.6	5,076.6	497.4
	Total, 3 days	13,913.0	−308.2	2,129.6	15,735.4	1,546.0
50	Mar. 30–31	3,580.0	−115.2	669.2	4,134.0	307.3
51	Mar. 31–Apr. 1	1,731.4	+ 19.9	611.0	2,362.3	....
	Apr. 1–2	1,826.8	− 50.7	572.1	2,348.2	....
	Total, 2 days	3,558.2	− 30.8	1,183.1	4,710.5	....

Balance of income and outgo of matter and energy.—Tables 55–58 contain the values of income and outgo of nitrogen, carbon, hydrogen,

and energy,[a] as summarized from the preceding tables. (See also Appendix, Tables 117–124.)

TABLE 55.—*Income and outgo of nitrogen and carbon, metabolism experiments Nos. 49–51.*

Date.	Nitrogen.				Carbon.				
	(a) In food.	(b) In feces.	(c) In urine.*	(d) Gain (+) or loss (−), a−(b+c).	(e) In food.	(f) In feces.	(g) In urine.†	(h) In respiratory products.	(i) Gain (+) or loss (−), e−(f+g+h).
1902.									
Experiment No. 49.	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
Mar. 27–28	18.67	2.09	16.08	+ 0.50	546.68	16.54	12.48	533.30	− 15.64
28–29	18.67	2.09	16.45	+ .13	546.68	16.54	12.77	498.26	+ 19.11
29–30	18.67	2.09	15.82	+ .76	546.68	16.54	12.27	495.81	+ 22.06
Total	56.01	6.27	48.35	+ 1.39	1,640.04	49.62	37.52	1,527.37	+ 25.53
Average, 1 day	18.67	2.09	16.12	+ .46	546.68	16.54	12.51	509.12	+ 8.51
Experiment No. 50.									
Mar. 30–31	11.07	1.18	13.92	− 4.03	236.26	11.13	10.86	374.89	−160.62
Experiment No. 51.									
Mar. 31–Apr. 1	....	....	11.73	−11.73	....	....	9.28	191.66	−200.94
Apr. 1–2	.98	....	13.23	−12.25	1.12	....	10.46	190.36	−199.70
Total	.98	....	24.96	−23.98	1.12	....	19.74	382.02	−400.64
Average, 1 day	.49	....	12.48	−11.99	.56	....	9.87	191.01	−200.32

*Nitrogen in the perspiration added to this column.
†Carbon in the perspiration added to this column.

TABLE 56.—*Income and outgo of water and hydrogen, metabolism experiments Nos. 49–51.*

Date.	Water.					
	(a) In food.	(b) In drink.	(c) In feces.	(d) In urine.	(e) In respiratory products.	(f) Apparent loss, a+b−(c+d+e).
1902.						
Experiment No. 49.	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
Mar. 27–28	2,291.60	2,800.0	170.1	1,954.15	3,513.98	− 546.63
28–29	2,291.60	2,800.0	170.1	2,204.35	3,060.22	− 343.07
29–30	2,291.60	2,800.0	170.1	2,648.25	3,030.94	− 757.69
Total	6,874.80	8,400.0	510.3	6,806.75	9,605.14	−1,647.39
Average, 1 day	2,291.60	2,800.0	170.1	2,268.92	3,201.71	− 549.13
Experiment No. 50.						
Mar. 30–31	1,579.40	1,300.0	92.4	1,625.55	2,232.23	−1,070.78
Experiment No. 51.						
Mar. 31–Apr. 1	....	750.0	....	971.12	1,017.99	−1,239.11
Apr. 1–2	564.50	250.0	....	727.98	895.29	− 808.77
Total	564.50	1,000.0	....	1,699.10	1,913.28	−2,047.88
Average, 1 day	282.25	500.0	....	849.55	956.64	−1,023.94

[a] In considering the income of energy during fasting, see remark on glycogen consumed, page 175.

TABLE 56.—*Income and outgo of water and hydrogen, etc.*—Continued.

Date.	Hydrogen. (g) In food.	(h) In feces.	(i) In urine.*	(k) Apparent gain, $g-(h+i)$.	(l) Loss from water, $f \div 9$.	(m) Total gain (+) or loss (−), $k+l$.
1902.						
Experiment No. 49.	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
Mar. 27–28	82.15	2.28	3.53	+ 76.34	− 60.74	+ 15.60
28–29	82.15	2.27	3.61	+ 76.27	− 38.12	+ 38.15
29–30	82.15	2.28	3.46	+ 76.41	− 84.18	− 7.77
Total	246.45	6.83	10.60	+229.02	−183.04	+ 45.98
Average, 1 day	82.15	2.28	3.53	+ 76.34	− 61.01	+ 15.33
Experiment No. 50.						
Mar. 30–31	35.78	1.63	3.07	+ 31.08	−118.98	− 87.90
Experiment No. 51.						
Mar. 31–Apr. 1	....	....	2.61	− 2.61	−137.68	−140.29
Apr. 1–2	.23	....	2.94	− 2.71	− 89.86	− 92.57
Total	.23	....	5.55	− 5.32	−227.54	−232.86
Average, 1 day	.12	....	2.78	− 2.66	−113.77	−116.43

*Hydrogen in perspiration included here.

TABLE 57.—*Gain or loss of protein ($N \times 6.25$), fat, and water, metabolism experiments Nos. 49–51.*

Date.	(a) Nitrogen gained (+) or lost (−).	(b) Protein gained (+) or lost (−), $a \times 6.25$.	(c) Total carbon gained (+) or lost (−).	(d) Carbon in protein gained (+) or lost (−), $b \times 0.53$.	(e) Carbon in fat, etc., gained (+) or lost (−), $c-d$.	(f) Fat gained (+) or lost (−), $e \div 0.7608$.
1902.						
Experiment No. 49.	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
Mar. 27–28	+ 0.50	+ 3.13	− 15.64	+ 1.66	− 17.30	− 22.74
28–29	+ .13	+ .81	+ 19.11	+ .43	+ 18.68	+ 24.55
29–30	+ .76	+ 4.75	+ 22.06	+ 2.52	+ 19.54	+ 25.69
Total	+ 1.39	+ 8.69	+ 25.53	+ 4.61	+ 20.92	+ 27.50
Average, 1 day	+ .46	+ 2.90	+ 8.51	+ 1.54	+ 6.97	+ 9.17
Experiment No. 50.						
Mar. 30–31	− 4.03	− 25.19	−160.62	−13.35	−147.27	−193.57
Experiment No. 51.						
Mar. 31–Apr. 1	−11.73	− 73.31	−200.94	−38.85	−162.09	−213.05
Apr. 1–2	−12.25	− 76.56	−199.70	−40.58	−159.12	−209.15
Total	−23.98	−149.87	−400.64	−79.43	−321.21	422.20
Average, 1 day	−11.99	− 74.94	−200.32	−39.72	−160.60	−211.10

TABLE 57.—*Gain or loss of protein* ($N \times 6.25$), *fat, and water, etc.*—Continued.

Date.	(*g*) Total hydrogen gained (+) or lost (−).	(*h*) Hydrogen in protein gained (+) or lost (−), $b \times 0.07$.	(*i*) Hydrogen in fat gained (+) or lost (−), $f \times 0.118$.	(*k*) Hydrogen in water, etc., gained (+) or lost (−), $g-(h+i)$.	(*l*) Water gained (+) or lost (−), $k \times 9$.
1902.					
Experiment No. 49.	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
Mar. 27–28	+ 15.60	+ 0.22	− 2.68	+ 18.06	+ 162.54
28–29	+ 38.15	+ .06	+ 2.90	+ 35.19	+ 316.71
29–30	− 7.77	+ .33	+ 3.03	− 11.13	− 100.17
Total	+ 45.98	+ .61	+ 3.25	+ 42.12	+ 379.08
Average, 1 day	+ 15.33	+ .20	+ 1.09	+ 14.04	+ 129.54
Experiment No. 50.					
Mar. 30–31	− 87.90	− 1.76	−22.84	− 63.30	− 569.70
Experiment No. 51.					
Mar. 31–Apr. 1	−140.29	− 5.13	−25.14	−110.02	− 990.18
Apr. 1–2	− 92.57	− 5.36	−24.68	− 62.53	− 562.77
Total	−232.86	−10.49	−49.82	−172.55	−1,552.95
Average, 1 day	−116.43	− 5.25	−24.91	− 86.27	− 776.48

TABLE 58.—*Income and outgo of energy, metabolism experiments Nos. 49–51.*

Date.	(*a*) Heat of combustion of food eaten.	(*b*) Heat of combustion of feces.	(*c*) Heat of combustion of urine.	(*d*) Estimated heat of combustion of protein, gained (+) or lost (−).	(*e*) Estimated heat of combustion of fat, gained (+) or lost (−).	(*f*) Estimated energy of material oxidized in the body, $a-(b+c+d+e)$.	(*g*) Heat determined.	(*h*) Heat determined greater (+) or less (−) than estimated, $(f-g)$.	(*i*) Heat determined greater (+) or less (−) than estimated, $(h \div f)$.
1902.									
Experiment No. 49.	*Calories.*	*Calories.*	*Calories.*	*Calories.*	*Calories.*	*Calories.*	*Calories.*	*Calories.*	*Per cent.*
Mar. 27–28	5,499	172	135	+ 17	− 217	5,392	5,494	+102	+1.9
28–29	5,499	172	134	+ 5	+ 234	4,954	5,164	+210	+4.2
29–30	5,499	172	136	+ 27	+ 245	4,919	5,077	+158	+3.2
Total	16,497	516	405	+ 49	+ 262	15,265	15,735	+470	....
Average, 1 day	5,499	172	135	+ 16	+ 88	5,088	5,245	+157	+3.1
Experiment No. 50.									
Mar. 30–31	2,601	128	118	−142	−1,847	4,344	4,134	−210	−4.8
Experiment No. 51.									
Mar. 31–Apr. 1	....	....	97	−414	−2,033	2,350	2,362	+ 12	+ .5
Apr. 1–2	13	....	107	−433	−1,995	2,334	2,348	+ 14	+ .6
Total	13	....	204	−847	−4,028	4,684	4,710	+ 26	....
Average, 1 day	7	....	102	−423	−2,014	2,342	2,355	+ 13	+ .6

METABOLISM EXPERIMENTS NOS. 52–55.

Experiment No. 50 of the previous series was unsuccessful because the quantity of fat in the ration was too large for the subject to dispose of in the form in which it was given (butter). Accordingly some changes were planned in the present series. The general plan for experiments Nos. 52–54 was the same as the original plan for experiments Nos. 46–48, except in two particulars. First, a considerable part of the fat in the present instance was furnished by cream instead of by butter, a change which made the ration entirely acceptable, and, second, the periods were of three days each. The order of the experiments of this series was: No. 52, work, fat diet; No. 53, work, carbohydrate diet; No. 54, work, fat diet, and No. 55, extra work, fat diet.

The preliminary digestion experiment began on April 17, 1902, with breakfast and continued four days. The subject entered the calorimeter on the evening of April 20 and retired at 11 p. m. Metabolism experiment No. 52 began at 7 a. m., April 21, and continued three days. The diet during the preliminary period and experiment No. 52 consisted of a basal ration, furnishing about 77 grams of protein and 2,860 calories of energy, to which was added enough cream to make the supply of nutrients and energy equal to the amounts desired. The total protein varied on different days from 106.1 grams to 106.6 grams and the energy from 5,472 to 5,480 calories, the fat of the diet furnishing on an average 57 per cent of the total energy. The slight variations in the ration from day to day were due to differences in the composition of the cream, of which a fresh supply was obtained and analyzed each day.

In experiment No. 53, which lasted three days, the diet was changed to the carbohydrate ration, largely by omitting the cream and part of the butter, by increasing the amount of cereal foods, and by adding milk sugar and cane sugar. The ration as thus altered furnished 105.1 grams of protein and 5,478 calories of energy per day, 73 per cent of the total energy being supplied by carbohydrates.

In experiment No. 54, which was likewise of three days' duration, a return was made to a fat diet similar to that of experiment No. 52. There was a basal ration furnishing 78.7 grams of protein and 2,913 calories of energy, which was supplemented by cream, so that the total ration furnished from 108.4 to 109.2 grams of protein and from 5,495 to 5,523 calories of energy per day, fat furnishing about 58 per cent of the total energy.

Experiment No. 55, which continued only one day, was peculiar in that the subject worked for sixteen hours, or twice as long as usual. The diet was practically the same as on the last day of experiment No. 54 and the programme was practically the same up to 7 p. m. It was then necessarily modified, as at 7.50 p. m. the subject began work

again and between that time and 7 a. m. worked for eight hours, sleeping only from 1 a. m. to 4 a. m.

Errors affecting experiments Nos. 52–55.—The check experiments made during the spring of 1902, in which alcohol was burned in the calorimeter, were in many respects unsatisfactory, especially as regards the excessive amount of water collected, and in the last experiment as regards the deficiency of carbon dioxid. (See Table 1, page 37.) The extra amount of water may be explained to a considerable extent, as has been said on page 17, by the conditions pertaining to the valves of the valve box (see fig. 3). Although this part of the apparatus was newly constructed and considerably better than that formerly used it was not entirely satisfactory; for the low temperature of the brine tank immediately below the valve box caused moisture to condense all over the latter, as the humidity of the air about it was very high. Moisture was likewise deposited on the interior of the tube projecting from the side of the valve box, to which the rubber connections to the freezer cans were attached. Later, when the cans were connected, the air from the chamber passing through the valves took up the moisture that had been condensed in them from the air and deposited it in the freezer cans, where it was weighed with that actually coming from the chamber. This increase in the amount of water seemed to be directly proportional to the number of hours which the experiment continued, as is seen by inspection of the results of the individual runs of the alcohol check experiments. Consequently it was assumed that about 2 grams per hour, or 48 grams of water per day, as a rule, entered the calorimeter system in the way mentioned. That this is not a percentage error but is dependent on the time is perfectly evident from the inspection of the results of the short periods of the alcohol check experiments, since the values obtained in short periods in which a large quantity of alcohol was burned showed a much closer agreement with the theoretical amounts than those of long periods in which a small amount of alcohol was burned. In metabolism experiments where this leak of water was the only known error, no correction was made in the tables for the water leaking in through the valve box.

During the last series of experiments reported it was found that some part of the Blakeslee pump was leaking; for it was observed that after each sample of air was thrown into the respective pans there was a decided drop in the rubber diaphragm as the valve was closed, indicating a defect in the mechanism. As this could not be remedied without stopping the experiment it was decided to complete the series and to determine, if possible, by means of the succeeding alcohol check experiment, how great this loss of air was.

After very careful examination it seemed apparent that the loss of air was due to a defect in the aliquoting apparatus, in which the opening

of one valve and the closing of another, instead of being simultaneous, as they should be, were irregular and unsatisfactory. An error arising from such a cause obviously would be a percentage error, and as a matter of fact, the subsequent alcohol check experiment demonstrated this point very clearly; for it was found that each individual run of the alcohol check experiment gave just about 92 per cent of the theoretical amount of carbon dioxid, which was interpreted as showing that 8 per cent of the air sample was lost before the valves closed properly. While so large a correction is undesirable and must of necessity lessen the value of an experiment, it seemed advisable to continue the investigation, including an experiment in which the subject performed an extra amount of work, and thus complete the series planned for the year. It is believed that both these corrections, i. e., that for water and that for carbon dioxid, when applied give results which are in reality not far from correct. Obviously, an experiment of as great importance as that with extra hard work must be repeated and the results compared with the present one to show whether the corrections introduced are justified.

The loss of air just described was first noticed early in the afternoon of April 22 (the second day of experiment No. 52), and the carbon dioxid determinations showed clearly that the leak began at about 1 p. m. of that day. Accordingly, the corrections were applied on the metabolism experiments of this series from 1 p. m. of the day mentioned. The values actually obtained for carbon dioxid in outgoing air and for the water not condensed in the freezers were divided by 0.92 to obtain the corrected values which are published. The values obtained for water condensed in the freezer are diminished by 5 grams for each 2-hour period for the same time, since the succeeding alcohol check experiment showed the excess to be 2.5 grams per hour. With these corrections a reasonably close balance of income and outgo of energy is obtained in all the experiments except the final day (experiment No. 55), where the discrepancy amounts to 6.7 per cent of the total energy metabolized. This will be referred to elsewhere. (See page 189, under carbohydrates and fats versus protein as sources of energy for muscular work.)

Statistics of income and outgo.—Tables 59–63, which follow, give the data of income and outgo of matter and energy in these experiments.

The amounts, composition, and heat of combustion of the food materials used for each experiment of this series are shown in Table 59. In Tables 60 and 61 will be found the composition and heats of combustion of the feces and urine. (See Tables 109–114, Appendix, for analyses.)

TABLE 59.—*Weight, composition, and heat of combustion of foods, metabolism experiments Nos. 52–55.*

Laboratory No.	Food materials.	Weight per day.	Water.	Protein.	Fat.	Carbohydrates.	Nitrogen.	Carbon.	Hydrogen.	Heat of combustion.
	Experiment No. 52.									
	BASAL RATION.	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Calories.*
3431	Butter	45	4.1	0.6	39.1	....	0.09	29.42	4.65	365
3420	Ginger snaps	60	3.3	3.7	3.8	47.3	.65	25.57	3.82	256
3421	Shredded wheat	40	3.2	4.2	.5	31.3	.74	16.34	2.37	160
3432	Bread	440	189.6	36.5	6.6	202.8	6.42	113.65	16.76	1,146
3436	Whole milk	850	727.6	31.5	41.7	42.5	5.10	64.60	9.86	721
	Sugar	45	....	....	....	45.0	....	18.95	2.92	178
3434	Cereal coffee	1,200	1,191.6	.5	....	7.2	.09	3.46	.48	34
	Total	2,680	2,119.4	77.0	91.7	376.1	13.09	271.99	40.86	2,860
	SUPPLEMENTAL RATION.									
3440	Cream *a*	1,140	798.0	29.6	245.1	60.4	4.67	217.28	33.63	2,615
	Total ration 1st day	3,820	2,917.4	106.6	336.8	436.5	17.76	489.27	74.49	5,475
3440	Cream	1,120	784.0	29.1	240.8	59.4	4.59	213.47	33.04	2,612
	Total ration 2d day	3,800	2,903.4	106.1	332.5	435.5	17.68	485.46	73.90	5,472
3440	Cream	1,120	784.0	29.1	240.8	59.4	4.59	213.47	33.04	2,620
	Total ration 3d day	3,800	2,903.4	106.1	332.5	435.5	17.68	485.46	73.90	5,480
	Experiment No. 53.									
3431	Butter	20	1.8	.3	17.4	....	.04	13.08	2.07	162
3433	Bread	550	228.8	46.8	9.4	259.6	8.25	146.30	21.56	1,465
3420	Ginger snaps	85	4.7	5.3	5.4	67.0	.92	36.23	5.41	362
3421	Shredded wheat	80	6.4	8.4	1.0	62.6	1.47	32.69	4.74	320
3422	Graham crackers	100	3.2	7.8	11.6	74.7	1.37	44.90	6.82	460
3437	Whole milk	1,000	858.0	36.0	51.0	47.0	5.80	75.30	11.60	838
	Cane sugar	370	....	....	....	370.0	....	155.77	23.98	1,465
3258	Milk sugar	100	5.1	....	....	94.9	....	40.00	6.15	372
3434	Cereal coffee	1,200	1,191.6	.5	....	7.2	.09	3.46	.48	34
	Total ration 1 day	3,505	2,299.6	105.1	95.8	983.0	17.94	547.73	82.81	5,478
	Experiments Nos. 54 and 55.									
	BASAL RATION.									
3431	Butter	45	4.1	.6	39.1	....	.09	29.42	4.65	365
3420	Ginger snaps	60	3.3	3.7	3.8	47.3	.65	25.57	3.82	256
3421	Shredded wheat	40	3.2	4.2	.5	31.3	.74	16.34	2.37	160
3433	Bread	440	183.0	37.4	7.5	207.7	6.60	117.04	17.25	1,172
3438	Milk	850	720.0	32.3	49.3	41.7	5.19	68.34	10.37	748
	Sugar	45	....	....	....	45.0	....	18.95	2.92	178
3434	Cereal coffee	1,200	1,191.6	.5	....	7.2	.09	3.46	.48	34
	Total	2,680	2,105.2	78.7	100.2	380.2	13.36	279.12	41.86	2,913
	Experiment No. 54.									
	SUPPLEMENTAL RATION.									
3441	Cream *a*	1,120	761.6	32.5	258.7	60.5	5.15	227.47	35.39	2,608
	Total ration 1st day	3,800	2,866.8	111.2	358.9	440.7	18.51	506.59	77.25	5,521
3441	Cream	1,025	697.0	29.7	236.8	55.4	4.72	208.18	32.39	2,582
	Total ration 2d day	3,705	2,802.2	108.4	337.0	435.6	18.08	487.30	74.25	5,495
3441	Cream	1,050	714.0	30.5	242.6	56.7	4.83	213.26	33.18	2,610
	Total ration 3d day	3,730	2,819.2	109.2	342.8	436.9	18.19	492.38	75.04	5,523
	Experiment No. 55.									
3441	Cream	1,010	686.8	29.3	233.3	54.5	4.65	205.13	31.92	2,595
	Beef tea	300	298.2	1.2	....	....	.42	.48	.09	6
	Total	3,990	3,090.2	109.2	333.5	434.7	18.43	484.73	73.87	5,514

[a] Heat of combustion determined on daily sample; chemical analyses made on 3 or 4 day composite.

TABLE 60.—*Weight, composition, and heat of combustion of feces, metabolism experiments Nos. 52–55.*

Laboratory No.		Weight.	Water.	Protein.	Fat.	Carbohydrates.	Nitrogen.	Carbon.	Hydrogen.	Heat of combustion.
	Experiment No. 52.	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Calories.*
3443	Feces, 3 days	703.0	590.5	29.6	18.3	42.9	4.73	59.26	8.72	684
	Average, 1 day	234.3	196.8	9.9	6.1	14.3	1.58	19.75	2.91	228
	Experiment No. 53.									
3444	Feces, 3 days	760.6	636.6	43.7	19.0	43.4	6.99	60.47	8.37	654
	Average, 1 day	253.5	212.2	14.6	6.3	14.5	2.33	20.16	2.79	218
	Experiments Nos. 54 and 55.									
3445	Feces, 4 days	829.3	667.6	42.4	28.2	62.2	6.79	83.51	12.19	969
	Average, 1 day	207.3	166.9	10.6	7.1	15.6	1.70	20.88	3.05	242

TABLE 61.—*Amount and composition of urine, metabolism experiments Nos. 52–55.*

Experiment No.	Date.	Amount.	Nitrogen.	Carbon.	Hydrogen.	Water.	Heat of combustion.
	1902.	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Calories.*
52	Apr. 21–22	2,128.1	15.36	11.55	3.53	2,060.8	123
	22–23	1,408.8	16.44	12.35	3.77	1,343.9	132
	23–24	1,884.6	16.16	12.14	3.71	1,816.7	128
	Total, 3 days	5,421.5	47.96	36.04	11.01	5,221.4	383
53	Apr. 24–25	998.6	14.19	10.67	3.26	944.3	119
	25–26	1,171.4	14.67	11.02	3.37	1,114.2	122
	26–27	1,451.4	15.76	11.85	3.62	1,388.3	142
	Total, 3 days	3.621.4	44.62	33.54	10.25	3,446.8	383
54	Apr. 27–28	2,401.8	16.25	12.22	3.73	2,329.4	125
	28–29	2,007.3	16.95	12.73	3.89	1,935.8	126
	29–30	2,055.2	16.62	12.49	3.82	1,984.4	144
	Total, 3 days	6,464.3	49.82	37.44	11.44	6,249.6	395
55	Apr. 30–May 1	1,168.8	17.37	13.05	3.99	1,102.8	145
52–55	Total, 10 days	16,676.0	159.77	120.07	36.69	16,020.6	1,306

Tables 62 and 63 summarize the figures for carbon dioxid and water in the ventilating air current and the amount of heat measured by the calorimeter. (See Tables 117–122 in the Appendix.)

TABLE 62.—*Record of carbon dioxid and water in ventilating air current, metabolism experiments Nos. 52–55.*

Experiment No.	Date.	(a) Volume of air.	Carbon dioxid. (b) In incoming air.	(c) In outgoing air.	(d) Correction for amount remaining in chamber.	(e) Amount exhaled by subject, c+d−b.	(f) Total carbon in respiratory products, $e \times \frac{3}{11}$.	Water. (g) In incoming air.	(h) In outgoing air.	(i) Correction for amount remaining in chamber.	(k) Total water of respiration and perspiration, h+i−g.
	1902.	Liters.	Grams.	Grams.	Grams.	Grams.	Grams	Grams.	Grams.	Grams.	Grams.
52	Apr. 21–22....	114,267	69.9	1,844.3	+ 2.3	1,776.7	484.6	169.2	1,401.9	+2,454.8	3,687.5
	22–23....	112,713	66.7	1,759.9	− 1.7	1,691.5	461.3	92.9	1,332.6	+2,177.7	3,417.4
	23–24....	113,490	61.6	1,764.3	− .8	1,701.9	464.1	113.9	1,347.4	+2,299.2	3,532.7
	Total ...	340,470	198.2	5,368.5	− .2	5,170.1	1,410.0	376.0	4,081.9	+6,931.7	10,637.6
53	Apr. 24–25....	111,159	61.8	1,859.6	+ 2.3	1,800.1	490.9	92.5	1,279.2	+1,948.6	3,135.3
	25–26....	113,490	63.7	1,971.5	+ .8	1,908.6	520.5	94.9	1,299.7	+2,118.8	3,323.6
	26–27....	113,490	64.1	2,007.2	0.0	1,943.1	529.9	106.7	1,312.5	+2,169.0	3,374.8
	Total ...	338,139	189.6	5,838.3	+ 3.1	5,651.8	1,541.3	294.1	3,891.4	+6,236.4	9,833.7
54	Apr. 27–28....	111,936	63.0	1,821.5	+ 1.2	1,759.7	479.9	120.6	1,286.8	+2,131.4	3,297.6
	28–29....	111,158	67.1	1,833.9	− 2.6	1,764.2	481.1	151.4	1,280.6	+2,309.0	3,438.2
	29–30....	113,490	68.1	1,811.7	+ 3.7	1,747.3	476.5	119.6	1,356.2	+2,213.5	3,450.1
	Total ...	336,584	198.2	5,467.1	+ 2.3	5,271.2	1,437.5	391.6	3,923.6	+6,653.9	10,185.9
55	Apr. 30–May 1	121,263	70.3	3,044.1	+99.8	3,073.6	838.3	183.0	1,665.8	+5,898.2	7,381.0

TABLE 63.—*Summary of calorimetric measurements, metabolism experiments Nos. 52–55.*

Experiment No.	Date.	(a) Heat carried away by water current.	(b) Correction for temperature of food and dishes and changes in temperature of calorimeter.	(c) Heat rendered latent in vaporization of water.	(d) Total heat determined, a+b+c.	(e) Heat equivalent of external muscular work.
	1902.	Calories.	Calories.	Calories.	Calories.	Calories.
52	Apr. 21–22	4,784.5	− 48.1	733.4	5,469.8	649.1
	22–23	4,465.5	− 38.2	732.3	5,159.6	585.5
	23–24	4,504.5	− 33.2	731.4	5,202.7	585.5
	Total, 3 days	13,754.5	−119.5	2,197.1	15,832.1	1,820.1
53	Apr. 24–25	4,360.9	− 36.3	704.0	5,028.6	576.5
	25–26	4,531.6	− 44.4	710.1	5,197.3	596.6
	26–27	4,652.5	− 59.1	714.5	5,307.9	588.9
	Total, 3 days	13,545.0	−139.8	2,128.6	15,533.8	1,762.0
54	Apr. 27–28	4,542.1	− 56.4	690.5	5,176.2	603.8
	28–29	4,625.9	− 41.8	668.8	5,252.9	589.2
	29–30	4,515.8	− 34.3	734.1	5,215.6	591.3
	Total, 3 days	13,683.8	−132.5	2,093.4	15,644.7	1,784.3
55	Apr. 30–May 1.....................	8,486.4	− 58.6	885.9	9,313.7	1,481.7

Balance of income and outgo of matter and energy.—Tables 64–67 summarize the figures for income and outgo of nitrogen, carbon, hydrogen, and energy. The values are determined from data in the preceding tables. Letters at the heads of the columns show the process by which the values in the columns were derived. (See Appendix, Tables 117–124.)

TABLE 64.—*Income and outgo of nitrogen and carbon, metabolism experiments Nos. 52–55.*

Date.	Nitrogen.				Carbon.				
	(*a*) In food.	(*b*) In feces.	(*c*) In urine.*	(*d*) Gain(+) or loss(−), *a*−(*b*+*c*).	(*e*) In food.	(*f*) In feces.	(*g*) In urine.†	(*h*) In respiratory products.	(*i*) Gain(+) or loss (−), *e*−(*f*+*g*+*h*).
1902.									
Experiment No. 52.	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
Apr. 21–22	17.7	1.6	15.9	+0.2	489.3	19.8	11.8	484.6	− 26.9
22–23	17.7	1.5	16.9	− .7	485.5	19.7	12.5	461.3	− 8.0
23–24	17.7	1.6	16.6	− .5	485.4	19.8	12.4	464.1	− 10.9
Total	53.1	4.7	49.4	−1.0	1,460.2	59.3	36.7	1,410.0	− 45.8
Average, 1 day	17.7	1.6	16.4	− .3	486.7	19.8	12.2	470.0	− 15.3
Experiment No. 53.									
Apr. 24–25	17.9	2.3	14.7	+ .9	547.7	20.2	10.9	490.9	+ 25.7
25–26	18.0	2.4	15.2	+ .4	547.7	20.1	11.2	520.5	− 4.1
26–27	17.9	2.3	16.2	− .6	547.7	20.2	12.1	529.9	− 14.5
Total	53.8	7.0	46.1	+ .7	1,643.1	60.5	34.2	1,541.3	+ 7.1
Average, 1 day	17.9	2.3	15.4	+ .2	547.7	20.2	11.4	513.7	+ 2.4
Experiment No. 54.									
Apr. 27–28	18.5	1.7	16.7	+ .1	506.6	20.9	12.5	479.9	− 6.7
28–29	18.1	1.7	17.5	−1.1	487.3	20.9	12.9	481.1	− 27.6
29–30	18.2	1.7	17.1	− .6	492.4	20.9	12.7	476.5	− 17.7
Total	54.8	5.1	51.3	−1.6	1,486.3	62.7	38.1	1,437.5	− 52.0
Average, 1 day	18.3	1.7	17.1	− .5	495.4	20.9	12.7	479.1	− 17.3
Experiment No. 55.									
April 30–May 1	18.4	1.7	18.3	−1.6	484.7	20.9	13.5	838.3	−388.0

* Including nitrogen in perspiration.

† Including carbon in perspiration.

TABLE 65.—*Income and outgo of water and hydrogen, metabolism experiments Nos. 52–55.*

Date.	Water. (a) In food.	(b) In drink.	(c) In feces.	(d) In urine.	(e) In respiratory products.	(f) Apparent loss, a+b−(c+d+e).
1902.						
Experiment No. 52.	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
Apr. 21–22	2,917.4	1,950.0	196.8	2,060.8	3,687.5	−1,077.7
22–23	2,903.4	1,950.0	196.9	1,343.9	3,417.4	− 104.8
23–24	2,903.4	1,950.0	196.8	1,816.7	3,532.7	− 692.8
Total	8,724.2	5,850.0	590.5	5,221.4	10,637.6	−1,875.3
Average, 1 day	2,908.1	1,950.0	196.8	1,740.5	3,545.9	− 625.1
Experiment No. 53.						
Apr. 24–25	2,299.6	1,950.0	212.2	944.3	3,135.3	− 42.2
25–26	2,299.6	1,950.0	212.2	1,114.2	3,323.6	− 400.4
26–27	2,299.6	1,950.0	212.2	1,388.3	3,374.8	− 725.7
Total	6,898.8	5,850.0	636.6	3,446.8	9,833.7	−1,168.3
Average, 1 day	2,299.6	1,950.0	212.2	1,148.9	3,277.9	− 389.4
Experiment No. 54.						
Apr. 27–28	2,866.8	1,950.0	166.9	2,329.4	3,297.6	− 977.1
28–29	2,802.2	1,950.0	166.9	1,935.8	3,438.2	− 788.7
29–30	2,819.2	1,950.0	166.9	1,984.4	3,450.1	− 832.2
Total	8,488.2	5,850.0	500.7	6,249.6	10,185.9	−2,598.0
Average, 1 day	2,829.4	1,950.0	166.9	2,083.2	3,395.3	− 866.0
Experiment No. 55.						
Apr. 30–May 1	3,090.2	2,850.0	166.9	1,102.8	7,381.0	−2,710.5

Date.	Hydrogen. (g) In food.	(h) In feces.	(i) In urine.*	(k) Apparent gain, g−(h+i).	(l) Loss from water, f÷9.	(m) Total gain (+) or loss (−), k+l.
1902.						
Experiment No. 52.	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
Apr. 21–22	74.5	2.9	3.6	+ 68.0	−119.8	− 51.8
22–23	73.9	2.9	3.8	+ 67.2	− 11.6	+ 55.6
23–24	73.9	2.9	3.8	+ 67.2	− 77.0	− 9.8
Total	222.3	8.7	11.2	+202.4	−208.4	− 6.0
Average, 1 day	74.1	2.9	3.7	+ 67.5	− 69.5	− 2.0
Experiment No. 53.						
Apr. 24–25	82.8	2.8	3.4	+ 76.6	− 4.7	+ 71.9
25–26	82.8	2.8	3.4	+ 76.6	− 44.5	+ 32.1
26–27	82.8	2.8	3.7	+ 76.3	− 80.6	− 4.3
Total	248.4	8.4	10.5	+229.5	−129.8	+ 99.7
Average, 1 day	82.8	2.8	3.5	+ 76.5	− 43.3	+ 33.2
Experiment No. 54.						
Apr. 27–28	77.2	3.1	3.8	+ 70.3	−108.6	− 38.3
28–29	74.3	3.0	4.0	+ 67.3	− 87.6	− 20.3
29–30	75.0	3.1	3.9	+ 68.0	− 92.5	− 24.5
Total	226.5	9.2	11.7	+205.6	−288.7	− 83.1
Average, 1 day	75.5	3.1	3.9	+ 68.5	− 96.2	− 27.7
Experiment No. 55.						
Apr. 30–May 1	73.9	3.0	4.1	+ 66.8	−301.2	−234.4

* Hydrogen from perspiration added to this column.

TABLE 66.—*Gain or loss of protein (N×6.25), fat, and water, metabolism experiments Nos. 52–55.*

Date.	(a) Nitrogen gained (+) or lost (−).	(b) Protein gained (+) or lost (−), a×6.25.	(c) Total carbon gained (+) or lost (−).	(d) Carbon in protein gained (+) or lost (−), b×0.53.	(e) Carbon in fat, etc., gained (+) or lost (−), c−d.	(f) Fat gained (+) or lost (−), e÷0.7608.
1902.						
Experiment No. 52.	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
Apr. 21–22	+0.2	+ 1.2	− 26.9	+0.7	− 27.6	− 36.3
22–23	− .7	− 4.4	− 8.0	−2.3	− 5.7	− 7.5
23–24	− .5	− 3.1	− 10.9	−1.7	− 9.2	− 12.1
Total	−1.0	− 6.3	− 45.8	−3.3	− 42.5	− 55.9
Average, 1 day	− .3	− 2.1	− 15.3	−1.1	− 14.2	− 18.6
Experiment No. 53.						
Apr. 24–25	+ .9	+ 5.6	+ 25.7	+3.0	+ 22.7	+ 29.8
25–26	+ .4	+ 2.5	− 4.1	+1.3	− 5.4	− 7.1
26–27	− .6	− 3.7	− 14.5	−2.0	− 12.5	− 16.4
Total	+ .7	+ 4.4	+ 7.1	+2.3	+ 4.8	+ 6.3
Average, 1 day	+ .2	+ 1.3	+ 2.4	+ .8	+ 1.6	+ 2.1
Experiment No. 54.						
Apr. 27–28	+ .1	+ .6	− 6.7	+ .3	− 7.0	− 9.2
28–29	−1.1	− 6.9	− 27.6	−3.6	− 24.0	− 31.6
29–30	− .6	− 3.7	− 17.7	−2.0	− 15.7	− 20.6
Total	−1.6	−10.0	− 52.0	−5.3	− 46.7	− 61.4
Average, 1 day	− .5	− 3.3	− 17.3	−1.8	− 15.5	− 20.5
Experiment No. 55.						
Apr. 30–May 1	−1.6	−10.0	−388.0	−5.3	−382.7	−503.1

Date.	(g) Total hydrogen gained (+) or lost (−).	(h) Hydrogen in protein gained (+) or lost (−), b×0.07.	(i) Hydrogen in fat gained (+) or lost (−), f×0.118.	(k) Hydrogen in water, etc., gained (+) or lost (−), g−(h+i).	(l) Water gained (+) or lost (−), k×9.
1902.					
Experiment No. 52.	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
Apr. 21–22	− 51.8	+0.1	− 4.3	− 47.6	− 428.4
22–23	+ 55.6	− .3	− .9	+ 56.8	+ 511.2
23–24	− 9.8	− .2	− 1.4	− 8.2	− 73.8
Total	− 6.0	− .4	− 6.6	+ 1.0	+ 9.0
Average, 1 day	− 2.0	− .1	− 2.2	+ .3	+ 3.0
Experiment No. 53.					
Apr. 24–25	+ 71.9	+ .4	+ 3.5	+ 68.0	+ 612.0
25–26	+ 32.1	+ .2	− .9	+ 32.8	+ 295.2
26–27	− 4.3	− .3	− 1.9	− 2.1	− 18.9
Total	+ 99.7	+ .3	+ .7	+ 98.7	+ 888.3
Average, 1 day	+ 33.2	+ .1	+ .2	+ 32.9	+ 296.1
Experiment No. 54.					
Apr. 27–28	− 38.3	+ .1	− 1.1	− 37.3	− 335.7
28–29	− 20.3	− .5	− 3.7	− 16.1	− 144.9
29–30	− 24.5	− .3	− 2.4	− 21.8	− 196.2
Total	− 83.1	− .7	− 7.2	− 75.2	− 676.8
Average, 1 day	− 27.7	− .2	− 2.4	− 25.1	− 225.6
Experiment No. 55.					
Apr. 30–May 1	−234.4	− .7	−59.4	−174.3	−1,568.7

TABLE 67.—*Income and outgo of energy, metabolism experiments Nos. 52–55.*

Date.	(*a*) Heat of combustion of food eaten.	(*b*) Heat of combustion of feces.	(*c*) Heat of combustion of urine.	(*d*) Estimated heat of combustion of protein gained (+) or lost (−).	(*e*) Estimated heat of combustion of fat gained (+) or lost (−).	(*f*) Estimated energy of material oxidized in the body, *a*−(*b*+*c*+*d*+*e*).	(*g*) Heat determined.	(*h*) Heat determined greater (+) or less (−) than estimated, *f*−*g*.	(*i*) Heat determined greater (+) or less (−) than estimated, *h*÷*f*.
1902.									
Experiment No. 52.	*Calories.*	*Calories.*	*Calories.*	*Calories.*	*Calories.*	*Calories.*	*Calories.*	*Calories.*	*Per cent.*
Apr. 21–22	5,475	228	123	+ 7	− 346	5,463	5,470	+ 7	−0.1
22–23	5,472	228	132	−24	− 72	5,208	5,159	− 49	− .9
23–24	5,480	228	128	−18	− 115	5,257	5,203	− 54	−1.0
Total	16,427	684	383	−35	− 533	15,928	15,832	− 96	—
Average, 1 day	5,476	228	128	−12	− 177	5,309	5,277	− 32	− .6
Experiment No. 53.									
Apr. 24–25	5,478	218	119	+32	+ 284	4,825	5,029	+204	+4.2
25–26	5,478	218	122	+14	− 68	5,192	5,197	+ 5	+ .1
26–27	5,478	218	142	−21	− 156	5,295	5,308	+ 13	+ .2
Total	16,434	654	383	+25	+ 60	15,312	15,534	+222	....
Average, 1 day	5,478	218	128	+ 8	+ 20	5,104	5,178	+ 74	+1.4
Experiment No. 54.									
Apr. 27–28	5,521	242	125	+ 3	− 88	5,239	5,176	− 63	−1.2
28–29	5,495	242	126	−39	− 301	5,467	5,253	−214	−3.9
29–30	5,523	242	144	−21	− 197	5,355	5,216	−139	−2.6
Total	16,539	726	395	−57	− 586	16,061	15,645	−416	....
Average, 1 day	5,513	242	132	−19	− 196	5,354	5,215	−139	−2.6
Experiment No. 55.									
Apr. 30–May 1	5,514	243	145	−56	−4,799	9,981	9,314	−667	−6.7

SUMMARY OF PLAN AND RESULTS OF THE EXPERIMENTS.

METABOLISM EXPERIMENTS NOS. 1–55, WITH CORRESPONDING DIGESTION AND TEST EXPERIMENTS.

Between February, 1896, and May, 1902, inclusive, 55 experiments, covering, all told, 171½ days, were made with the respiration calorimeter. This includes the 21 experiments (Nos. 35–55) reported in the present bulletin. The discussion in the following pages is based on the experiments as a whole, those here reported being discussed by themselves only so far as is necessary for a clear understanding of them, or where the results of these particular experiments afford the best illustration of some of the topics discussed. A chronological list of all the experiments is given on page 101.

Subjects.—Five different men served as subjects of the experiments. E. O. was a Swede by birth, and has received his training in laboratory work in connection with the respiration calorimeter and related

investigations. He is now employed as analyst and laboratory assistant. The others were university-bred men and were natives of the United States, except J. F. S., who was a Canadian. O. F. T. and J. F. S. were chemists, and A. W. S. was a physicist. All three were assistants in this laboratory. J. C. W. at the time of the experiments was a student in Wesleyan University. All were in excellent health. The ages and physical measurements of the subjects are shown in the tabular statement herewith, the figures for body surface being computed from those for body weight by use of the formula of Meeh,[a] $S = 12.312 \times \sqrt[3]{W^2}$, when S = surface of the skin in square centimeters and W the weight of the body in grams.

TABLE 68.—*Age, weight, and body measurements of subjects of metabolism experiments Nos. 1–55.*

Subject.	Age.	Weight.		Height.		Normal chest measure.		Body surface.	
	Years.	*Pounds.*	*Kilo.*	*Ft. in.*	*Meters.*	*Inches.*	*Cm.*	*Sq. feet.*	*Square meters.*
E. O	31–34	154	70	5 8	1.73	37.0	94.1	22.50	2.09
O. F. T	24	132	60	5 6¼	1.68	36.4	92.5	20.34	1.89
A. W. S	22–25	154	70	5 9	1.76	35.8	90.0	22.50	2.09
J. F. S	29	143	65	5 7½	1.71	32.9	83.0	21.42	1.99
J. C. W	21–23	168	76	5 10	1.78	37.0	94.1	23.79	2.21

Respiration experiments.—In the first four experiments the food, drink, feces, urine, and respiratory products were weighed, measured, and analyzed, but there were no determinations of the heat given off from the body nor of the heat equivalents of external muscular work.[b] Accordingly they are here designated, for convenience, as "respiration experiments." They were made with three different subjects, E. O., O. F. T., and A. W. S., and covered 21½ days; but they may, for convenience, be divided into eight separate tests, in six of which (covering 15½ days) the subjects were at rest, in one (covering 3 days) the subject was engaged in active muscular work, and in another (also covering 3 days) he was engaged in active mental work.

Metabolism experiments.—The remaining experiments, Nos. 5–55, included measurements of energy in addition to the other determinations, and are here called "metabolism experiments" for convenience. Of the 30 experiments from Nos. 5 to 34, inclusive, 19 have been reported in former publications of this Office,[c] and 11 have been reported elsewhere,[d] as they belong to another investigation. The remaining 21

[a] Ztschr. Biol., 15 (1879), p. 440. See also Vierordt, Daten und Tabellen, 1893, p. 36.

[b] U. S. Dept. Agr., Office of Experiment Stations Bul. 44 and Bul. 109, p. 121.

[c] U. S. Dept. Agr., Office of Experiment Stations Buls. 63, 69, and 109.

[d] An experimental inquiry regarding the nutritive value of alcohol, W. O. Atwater and F. G. Benedict, Mem. Nat. Acad. Sci., 8 (1902), VI (U. S. Senate Doc. No. 233, 57th Cong., 1st sess.), p. 231.

experiments, Nos. 35–55, inclusive, covering 57 days, are described in the present report. The total number of experiments with measurements of income and outgo of energy in the body is thus 51, and the time covered by them is 150 days.

Rest and work experiments.—The metabolism experiments are divided into two classes: (1) Those in which the subjects were practically at rest, i. e., had no more exercise than was involved in dressing and undressing, and care of furniture, food, and excreta; and (2) those in which they were engaged in more or less severe muscular work.

The larger number of rest experiments were made with E. O., and J. C. W. was the subject of the larger number of work experiments. Of the 26 rest experiments, covering 72 days, several were with special diets, and 4, covering a total of 5 days, were with the subject J. C. W. fasting.

The 25 work experiments, covering a total of 78 days, were all made with special diets; 9, covering 32 days, with a diet furnishing an abundance of carbohydrates; 13, covering 36 days, with a diet furnishing an abundance of fat, and 3, covering 10 days, with alcohol as the special feature, the latter, as previously noted, being made in connection with another investigation.

Digestion experiments.—Each metabolism experiment or series of metabolism experiments from Nos. 5 to 55, inclusive, was immediately preceded by and continuous with an experiment during which the subject had practically the same ration and followed as nearly as possible the same routine as was observed during the metabolism experiment proper, when he was to be in the respiration chamber of the calorimeter. The main object of the preliminary period was to accustom him to the regimen and bring his body into approximate nitrogen and carbon equilibrium before the metabolism experiment proper began; but the opportunity was utilized to make a so-called preliminary digestion experiment. This was easily done by separating the feces belonging to the preliminary period from that of the following metabolism experiment and analyzing both food and feces of the preliminary period in the usual manner. As the food and feces of the metabolism experiments were necessarily analyzed, the periods within the respiration chamber also include digestion experiments. We thus have for each metabolism experiment, or series of experiments, two digestion experiments, in one of which the subject lived under ordinary conditions, while during the other he was in the respiration chamber.

The preliminary digestion experiments, with metabolism experiments Nos. 5–55, were 24 in number and covered 98 days, each being generally of 4 days' duration. Twelve, with a total of 51 days, were made with E. O.; 1, of 4 days, was with A. W. S.; 4, covering 16 days, were with J. F. S., and 7, covering 27 days, with J. C. W.

In respiration experiments Nos. 1–4 the arrangement for digestion experiments was different. Although each of these four experiments was preceded by a period during which the subject had a diet similar to that of the respiration experiment, a separation of feces corresponding to the two periods was not made; but the feces of the total time of both the preliminary period and that of the experiment within the chamber were compared with the food for the same time, thus making a single digestion experiment for the entire period in each case.

Check experiments.—The accuracy of the apparatus and method was frequently tested. The most common test was made by burning known quantities of ethyl alcohol in the respiration chamber and comparing the amounts of carbon dioxid, water, and heat measured by the apparatus with the theoretical amounts. Such tests are here called "alcohol check" experiments. In the other electricity was transformed into heat in the respiration chamber. These are called "electrical check" experiments.

List of the experiments.—A chronological list of the experiments is given herewith. This shows the classification, dates, and order of sequence of the preliminary digestion, metabolism, and alcohol check experiments, and gives the laboratory number by which each is designated in this and other reports, the experiments being grouped in series for convenience of discussion. In the case of the earlier experiments (Nos. 1–14) the grouping is somewhat arbitrary. Thus the four respiration experiments are classed as series 1, while others are subdivided according to experimental season, as series 2 and 3, or questions studied, as series 4. The experiments following No. 14 were planned in series. Each of the latter series, Nos. 5–18, made in 1899–1902, includes a preliminary digestion experiment and several closely related metabolism experiments, and most of them one or more check experiments.

TABLE 69.—*Chronological list of metabolism experiments Nos. 1–55, with corresponding preliminary digestion experiments and intervening check experiments.*

Date.	Check experiment No.	Digestion experiment No.[a]	Metabolism experiment No.	Subject.	Duration.	Work or rest.	Special characteristics of ration.	In food per day. Total protein, N×6.25.	In food per day. Available energy.
Metabolism (respiration) experiments without calorimetric measurements.[b]									
SERIES 1, 1896.					*Days.*			*Grams.*	*Calories.*
Feb. 15–17	......	11	......	E. O	$2\frac{5}{12}$	Rest	Ordinary	141.8	3,229
17–19	......	11	1	...do	$2\frac{1}{4}$	...do	...do	141.8	3,229
24–26	......	12	......	...do	$2\frac{5}{12}$	...do	...do	119.8	2,924
26–28	......	12	2	...do	$2\frac{1}{4}$	...do	...do	119.8	2,924
Mar. 13–16	......	13	......	O. F. T.	$3\frac{1}{3}$	...do	...do	95.9	2,643
16–21	......	13	3	...do	5	...do	...do	95.9	2,643
19–23	......	14	......	A. W. S.	$4\frac{2}{3}$	...do	...do	101.3	2,741
23–25	......	14	4p	...do	$1\frac{5}{8}$	...do	...do	101.3	2,741
25–28	......	14	4A	...do	3	Mental work.	...do	101.3	2,741
28–31	......	14	4B	...do	3	Rest	...do	101.3	2,741
31–Apr. 3	......	14	4C	...do	3	Musc'r work.	...do	101.3	2,741
Apr. 3– 4	......	14	4S	...do	$1\frac{3}{8}$	Rest	...do	101.3	2,741
Metabolism experiments with calorimetric measurements.									
SERIES 2, 1897.									
Apr. 27–29[c]	1	......	......	......	......	......	......	......	......
26–May 4[d]	......	37p	......	E. O	8	Rest	Ordinary	117.8	2,683
May 4– 8	......	38m	5	...do	4	...do	...do	119.1	2,655
10–11	2	......	......	......	......	......	......	......	......
14–18[c]	......	39p	......	E. O	4	Work	Ordinary	116.0	3,684
18–22[d]	......	40m	6	...do	4	...do	...do	119.1	3,678
26–27	3	......	......	......	......	......	......	......	......
June 4– 8[e]	......	41p	......	E. O	5	Rest	Special	104.0	2,469
8–12[d]	......	42m	7	...do	4	...do	...do	104.4	2,462
SERIES 3, 1897–98.									
Oct. 27–28	4	......	......	......	......	......	......	......	......
Nov. 2– 3	5	......	......	......	......	......	......	......	......
4– 8[c]	......	43p	......	E. O	4	Rest	Carbohydrate	122.5	2,935
8–12[d]	......	44m	8	...do	4	...do	...do	129.4	2,897
Dec. 2	6	......	......	......	......	......	......	......	......
Jan. 6	7	......	......	......	......	......	......	......	......
6–10[c]	......	45p	......	E. O	4	Rest	Carbohydrate	116.0	2,706
10–14[d]	......	46m	9	...do	4	...do	...do	119.6	2,717
24–27	8	......	......	......	......	......	......	......	......
Feb. 11–15[e]	......	47p	......	E. O	4	Rest	Special	120.0	2,699

[a] The digestion experiments which preceded the metabolism experiments are designated by "p," and those which were parts of the metabolism experiments by "m." In series 1 the two were not separated.

[b] U. S. Dept. Agr., Office of Experiment Stations Bul. 44.

[c] Connecticut (Storrs) Station Rpt. 1901, p. 178.

[d] U. S. Dept. Agr., Office of Experiment Stations Bul. 69.

[e] Mem. Nat. Acad. Sci., 8 (1902), VI (U. S. Senate Doc. No. 233, 57th Cong., 1 sess.), p. 231.

TABLE 69.—*Chronological list of metabolism experiments Nos. 1–55, etc.*—Continued.

Date.	Check experiment No.	Digestion experiment No.	Metabolism experiment No.	Subject.	Duration.	Work or rest.	Special characteristics of ration.	In food per day. Total protein, N×6.25.	Available energy.
Metabolism experiments with calorimetric measurements—Cont'd.									
SERIES 3, 1897–98—continued.					*Days.*			*Grams.*	*Calories.*
Feb. 15–19 [a]		48m	10	E. O	4	Rest	Special	123.5	2,709
Mar. 18–22 [b]		49p		do	4	Work	Carbohydrate	121.0	3,860
22–26 [c]		50m	11	do	4	do	do	124.1	3,862
Apr. 8–12 [d]		51p		do	4	do	Special	120.0	3,953
12–16 [d]		52m	12	do	4	do	do	120.6	3,891
May 9	9								
SERIES 4, 1898.									
Nov. 3–4	10								
4–8 [b]		76p		E. O	4	Rest	Carbohydrate	115.5	2,622
8–11 [c]		77m	13	do	3	do	do	117.1	2,596
15–16	11								
Dec. 13–14	12								
16–20 [b]		78p		E. O	3	Rest	Carbohydrate	91.7	2,449
20–24 [c]		79m	14	do	4	do	do	94.4	2,513
SERIES 5, 1899.									
Jan. 12–16 [d]		80p		E. O	4	Rest	Special	102.0	2,638
16–18 [d]		81m	15	do	2	do	do	108.9	2,653
18–20 [d]		81m	16	do	2	do	do	108.9	2,653
20–22 [d]		81m	17	do	2	do	do	108.9	2,653
SERIES 6, 1899.									
Feb. 2–6 [d]		82p		A. W. S.	4	Rest	Special	96.9	2,776
6–8 [d]		82m	18	do	2	do	do	96.9	2,776
8–10 [d]		82m	19	do	2	do	do	96.9	2,776
10–12 [d]		82m	20	do	2	do	do	96.9	2,776
12–15 [c]		82m	21	do	3	do	Ordinary	96.9	2,264
24–25	13								
SERIES 7, 1899.									
Mar. 9–13 [d]		83p		E. O	4	Rest	Special	121.0	2,647
13–16 [d]		84m	22	do	3	do	do	123.2	3,044
16–19 [c]		84m	23	do	3	do	Ordinary	123.6	2,546
19–22 [c]		85m	24	do	3	do	Carbohydrate	123.6	3,061
29–31	14								
Dec. 13–14	15								
19–21	16								
SERIES 8, 1900.									
Jan. 19–23 [b]		147p		J. F. S.	4	Rest	Carbohydrate	106.2	2,897
23–26 [c]		148m	25	do	3	do	do	110.8	2,896
SERIES 9, 1900.									
Feb. 10–14 [b]		149p		J. F. S.	4	Rest	Fat	96.8	2,517
14–17 [c]		150m	26	do	3	do	do	99.6	2,490
17–20 [c]		151m	27	do	3	do	Special	98.6	2,491
20–23 [c]		152m	28	do	3	do	Carbohydrate	98.6	2,489

[a] U. S. Dept. Agr., Office of Experiment Stations Bul. 69.
[b] Connecticut (Storrs) Station Rpt. 1901, p. 178.
[c] U. S. Dept. Agr., Office of Experiment Stations Bul. 109.
[d] Mem. Nat. Acad. Sci., 8 (1902), VI (U. S. Senate Doc. No. 233, 57th Cong., 1 sess.), p. 231.

TABLE 69.—*Chronological list of metabolism experiments Nos. 1–55, etc.*—Continued.

Date.	Check experiment No.	Digestion experiment No.	Metabolism experiment No.	Subject.	Duration.	Work or rest.	Special characteristics of ration.	In food per day.	
								Total protein, N×6.25.	Available energy.
Metabolism experiments with calorimetric measurements—Cont'd.									
SERIES 10, 1900.					*Days.*			*Grams.*	*Calories.*
Mar. 12–16 [a]	....	153p	....	J. F. S...	4	Work...	Carbohydrate	96.0	3,405
16–19 [b]	....	154m	29	....do...	3	....do...	....do.......	100.1	3,487
19–22 [c]	....	155m	30	....do...	3	....do...	Special.......	99.2	3,458
22–25 [b]	....	156m	31	....do...	3	....do...	Fat..........	100.9	3,495
SERIES 11, 1900.									
Apr. 6– 7	17	....	....	....	.....	....	....	....	.....
16–20 [a]	....	157p	....	J. F. S...	4	Work...	Fat..........	96.0	3,495
20–23 [b]	....	158m	32	....do...	3	....do...	....do.......	100.5	3,487
23–26 [c]	....	159m	33	....do...	3	....do...	Special.......	99.7	3,486
26–29 [b]	....	160m	34	....do...	3	....do...	Carbohydrate	99.7	3,493
SERIES 12, 1900.									
Dec. 4– 6	18	....	....	....	.....	....	....	....	....
5– 9 [a]	....	189p	....	J. C. W..	4	Rest....	Carbohydrate	94.0	1,751
9–13 [d]	....	190m	35	....do...	4	....do...	....do.......	97.7	2,519
13–14 [d]	....	....	36	....do...	1	....do...	Fasting.......	....	....
14–15	19	....	....	....	.....	....	....	....	....
SERIES 13, 1901.									
Jan. 8–11 [a]	....	192p	....	J. C. W..	3	Work...	Carbohydrate	92.0	2,921
11–15 [d]	....	193m	37	....do...	4	....do...	....do.......	100.4	3,715
15–19 [d]	....	194m	38	....do...	4	....do...	Fat..........	102.6	3,708
19–20 [d]	....	....	39	....do...	1	Rest....	Fasting.......	....	....
SERIES 14, 1901.									
Feb. 22–23	20	....	....	....	.....	....	....	....	....
22–26 [a]	....	195p	....	J. C. W..	4	Work...	Carbohydrate	101.5	4,355
26–Mar. 2 [d]	....	196m	40	....do...	4	....do...	....do.......	101.7	4,505
Mar. 2– 6 [d]	....	197m	41	....do...	4	....do...	Fat..........	102.6	4,539
6– 7 [d]	....	....	42	....do...	1	Rest....	Fasting.......	....	....
7– 8	21	....	....	....	.....	....	....	....	....
SERIES 15, 1902.									
Mar. 22–23	22	....	....	....	.....	....	....	....	....
25–29 [a]	....	198p	....	J. C. W..	4	Work...	Fat..........	96.0	4,258
29–Apr. 2 [d]	....	199m	43	....do...	4	....do...	....do.......	104.0	4,867
Apr. 2– 6 [d]	....	200m	44	....do...	4	....do...	Carbohydrate	104.4	4,932
6– 7 [d]	....	201m	45	....do...	1	....do...	Fat..........	105.3	4,860
SERIES 16, 1901.									
Apr. 29–May 3 [a]	....	202p	....	J. C. W..	4	Work...	Fat..........	102.0	4,832
May 3– 7 [d]	....	203m	46	....do...	4	....do...	....do.......	103.0	4,836
7–11 [d]	....	204m	47	....do...	4	....do...	Carbohydrate	102.2	4,710
11–12 [d]	....	205m	48	....do...	1	....do...	Fat..........	103.0	4,856

[a] Connecticut (Storrs) Station Rpt. 1901, p. 178.
[b] U. S. Dept. Agr., Office of Experiment Stations Bul. 109.
[c] Mem. Nat. Acad. Sci., 8 (1902), VI (U. S. Senate Doc. No. 233, 57th Cong., 1 sess.), p. 231
[d] The present bulletin.

TABLE 69.—*Chronological list of metabolism experiments Nos. 1–55, etc.*—Continued.

Date.	Check experiment No.	Digestion experiment No.	Metabolism experiment No.	Subject.	Duration.	Work or rest.	Special characteristics of ration.	In food per day. Total protein, N×6.25.	Available energy.
Metabolism experiments with calorimetric measurements—Cont'd.									
SERIES 17, 1902.					*Days.*			*Grams.*	*Calories.*
Mar. 5–8	23								
12–14	24								
18–20	25								
23–27[a]		302p		J. C. W.	4	Work	Carbohydrate	104.2	5,374
27–30[b]		303m	49	do	3	do	do	110.8	5,499
30–31[b]		304m	50	do	1	do	Fat	65.2	2,601
31–Apr. 2[b]			51	do	2	Rest	Fasting		
SERIES 18, 1902.									
Apr. 11–12	26								
17–21[a]		305p		J. C. W.	4	Work	Fat	99.3	5,032
21–24[b]		306m	52	do	3	do	do	106.3	5,476
24–27[b]		307m	53	do	3	do	Carbohydrate	105.1	5,478
27–30[b]		308m	54	do	3	do	Fat	109.6	5,513
30–May 1[b]		308m	55	do	1	do	do	109.2	5,514
May 1–2	27								

[a] Connecticut (Storrs) Station Rpt. 1901, p. 178.
[b] The present bulletin.

DISCUSSION OF RESULTS.

The experiments with J. C. W., reported in the present bulletin, and those with other subjects previously recorded, and here summarized, afford material for the discussion of questions connected with the fundamental laws of nutrition and related topics. Many of these are treated of in the following pages, including, in addition to discussions of the character and composition of the food materials used, the digestibility of the nutrients supplied, the availability of their energy, and a summary of the data of income and outgo of the individual experiments; a discussion of the demands of the body for nourishment and dietary standards; the elimination of carbon dioxid, water, and heat, including both total quantities and quantities per kilogram of body weight and per square meter of body surface; body temperature and temperature measurements; heat production versus heat elimination; estimates of the amounts of oxygen consumed; respiratory and carbon dioxid thermal quotients; carbohydrates (glycogen) in the body; the amounts of energy derived from different nutrients; fats versus carbohydrates as protectors of body material, especially protein and body fat; fats versus carbohydrates as sources of energy for muscular work; carbohydrates and fat versus protein as sources of energy for muscular work; the efficiency of the body as a

machine, and the conservation of energy in the body. In nearly every case these topics are subdivided into several questions, or are treated from different points of view. In most cases the discussion has been confined to the results brought out by the experiments with the respiration calorimeter, and it is to be particularly observed that the present report is confined almost exclusively to a statement of results obtained in our own experiments. The details are so extensive as to forbid the including of an adequate comparison of these experiments with others.

KINDS, AMOUNTS, AND COMPOSITION OF FOOD MATERIALS.

Table 109 of the Appendix gives the percentage composition of the food materials used during the metabolism experiments herein reported, and the kinds and amounts used in each experiment are shown in the tables for each series where the menus and rations are described. Similar data for experiments Nos. 1–34 may be found in earlier publications. (See Table 69, page 101, for references.)

In general, it may be said that except in the fasting experiments the diet was made up of ordinary food materials of good quality, and with as much variety as was consistent with convenience in preparation and accuracy in sampling and analyzing. For the sake of greater accuracy, the number of different materials used was somewhat less in the later than in the earlier experiments. The quantities of nutrients in the diet were in general such as to maintain the body nearly in nitrogen and carbon equilibrium under the conditions of the experiment. In a few cases, however, in which the muscular work was considerable, the diet was not quite sufficient for body maintenance, and there was consequently more or less draft upon the store of body material. The purpose of the preliminary digestion period being to accustom the subject to the diet and to determine whether under the conditions of the experiment nitrogen equilibrium could be maintained on the ration provided, any change found necessary or desirable was made during this period. This will explain the slight discrepancies seen in some of the tables between the quantities of food in the preliminary period and in the calorimeter period.

DIGESTIBILITY OF FOOD AND AVAILABILITY OF ENERGY.

In order to secure data for a balance of income and outgo, it is necessary to determine the ingredients of the feces, thus affording means for estimating the digestibility of the food. Accordingly, in these experiments the digestibility of the different nutrients was found by the usual method of comparing the quantity of each in the original food material with the quantity of the corresponding ingredient in the intestinal excreta. In the case of the energy, that of the unoxidized material of the urine was also taken into account. The

results of the digestion experiments which pertain to and form part of these metabolism experiments have been reported elsewhere in detail,[a] and are summarized in the present bulletin.

In considering such experiments it is a common practice to regard the solid excreta as representing the indigestible portion of the food only. This, however, is not quite accurate, because the feces include, besides the undigested residues of the food, some residues of digestive juices and other materials, so that the amounts of protein, ether extract, carbohydrates, and ash determined in the feces are larger than in the portion of the food which escapes digestion, and the proportions of digestible nutrients, when calculated as the difference between total food and total feces, are thus made too small. On the other hand, the total material of the feces does represent that which was not utilized by the body for the two chief purposes of nutrition—the building of tissue and the yielding of energy.

It is believed that the digestive powers of the three young men who served as subjects in the 50 digestion experiments here summarized were unimpaired. The individual experiments were generally 3 or 4 days in length, though a few covered 1 day only, while one continued 8 days. Eighteen of the experiments were carried on while the subjects were outside the calorimeter, and 32 formed part of the metabolism experiments with the subjects in the respiration chamber. The external muscular work performed by the subjects ranged in different experiments from an amount so small that it may be neglected to 16 hours' hard work a day in one of the work experiments, though in the majority of these experiments the period of work covered only 8 hours. The diet was simple, and contained a number of common food materials, both animal and vegetable. In 18 of the studies the quantities of the different nutrients were about the same as in an ordinary ration. In 17 experiments the diet contained large quantities of fat, and in 14 large quantities of carbohydrates, though the energy in these cases was not greater than was required to satisfy the needs of the body under the conditions of the experiments.

The results as regards the digestibility of the nutrients and the availability of energy in the different preliminary and metabolism experiments are summarized in the following table, the experiments being grouped in accordance with the conditions just described.

[a] Connecticut (Storrs) Station Rpt. 1901, p. 179.

TABLE 70.—*Summary of results of digestion experiments.*[a]

Digestion experiment No.	Metabolism experiment No.	Subject and character of experiment.	Coefficents of digestibility.				
			Protein.	Fat.	Carbohydrates.	Ash.	Availability of energy.
		Preliminary period.					
		REST EXPERIMENTS.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
37	5	E. O	92.6	94.0	98.0	75.2	90.0
43	8	.....do	91.0	94.4	97.4	73.1	89.9
45	9	.....do	90.8	92.1	95.8	73.0	88.5
76	13	.....do	96.8	96.3	98.9	86.5	93.1
78	14	.....do	92.0	93.4	98.5	79.1	91.1
		Average of above 5 experiments	92.6	94.0	97.7	77.4	90.5
147	25	J. F. S	93.9	96.8	97.7	69.8	91.7
149	26	J. F. S., fat diet	88.6	94.1	95.7	44.4	87.5
		Average of above 2 experiments	91.3	95.4	96.7	57.1	89.6
189	35	J. C. W	93.1	96.4	98.4	77.6	87.4
		Average of above 8 rest experiments.	92.4	94.7	97.6	72.3	89.9
		WORK EXPERIMENTS.					
39	6	E. O	89.9	95.3	97.6	72.6	91.2
49	11	.....do	90.3	93.2	97.8	74.4	91.4
		Average of above 2 experiments	90.1	94.2	97.7	73.5	91.3
153	29	J. F. S., carbohydrate diet	94.3	96.4	98.7	76.3	93.2
157	32	J. F. S., fat diet	90.4	95.7	96.8	69.9	91.0
		Average of above 2 experiments	92.3	96.1	97.8	73.1	92.1
192	37	J. C. W., carbohydrate diet	90.6	96.6	98.6	80.0	90.7
195	40	.....do	86.7	93.5	98.0	71.1	91.8
198	43	J. C. W., fat diet	87.3	96.6	96.0	62.5	91.7
202	46	.....do	87.5	95.3	97.8	69.9	92.1
202	49	J. C. W., carbohydrate diet	85.1	94.5	93.7	72.4	93.8
305	52	J. C. W., fat diet	91.7	98.0	97.2	72.3	93.7
		Average of above 6 experiments	88.2	95.8	96.9	71.4	92.3
		Average of above 10 work experiments	89.4	95.5	97.2	72.1	92.1
		Average of 18 experiments, preliminary period	90.7	95.1	97.4	72.2	91.1
		Calorimeter period.					
		REST EXPERIMENTS.					
38	5	E. O	91.2	93.9	97.7	75.3	89.8
44	8	.....do	93.9	95.6	98.2	78.7	90.7
46	9	.....do	93.4	93.9	96.5	78.9	89.3
77	13	.....do	93.9	93.2	98.1	76.4	90.2
79	14	.....do	94.4	95.5	98.9	86.2	91.1
84	23	.....do	94.3	94.7	97.8	70.0	90.0
85	24	E. O., carbohydrate diet	93.3	93.7	98.5	74.0	91.8
		Average of above 7 experiments	93.5	94.4	98.0	77.1	90.4
148	25	J. F. S., fat diet	94.4	97.4	97.4	71.4	91.1
150	26	.....do	92.8	97.2	97.3	66.0	90.6
152	28	J. F. S., carbohydrate diet	92.0	90.1	98.6	69.0	90.4
		Average of above 3 experiments	93.1	94.9	97.8	68.8	90.7
190	35	J. C. W	92.1	95.3	97.8	69.4	90.3
		Average of above 11 rest experiments.	93.2	94.6	97.9	74.1	90.5

[a] The digestion experiments connected with metabolism experiments Nos. 7, 10, 12, 15–23, and 27 are not included here, as they belong to a study of a special diet, as explained elsewhere.

TABLE 70.—*Summary of results of digestion experiments*—Continued.

Digestion experiment No.	Metabolism experiment No.	Subject and character of experiment.	Coefficents of digestibility.				
			Protein.	Fat.	Carbohydrates.	Ash.	Availability of energy.
		Calorimeter period—Continued.					
		WORK EXPERIMENTS.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
40	6	E. O	91.8	96.9	98.3	79.8	92.8
50	11	....do	88.4	93.0	97.5	71.8	90.9
		Average of above 2 experiments	90.1	94.9	97.9	75.8	91.9
154	29	J. F. S., carbohydrate diet	94.5	97.2	98.7	80.0	93.5
156	31	J. F. S., fat diet	94.8	98.3	98.2	80.4	93.7
158	32	....do	92.5	97.1	97.4	73.2	92.5
160	34	J. F. S., carbohydrate diet	92.4	95.0	98.4	68.6	92.8
		Average of above 4 experiments	93.5	96.9	98.2	75.6	93.1
193	37	J. C. W., carbohydrate diet	90.1	94.2	98.8	69.4	93.0
194	38	J. C. W., fat diet	92.7	96.7	97.4	67.5	91.7
196	40	J. C. W., carbohydrate diet	87.0	91.7	98.5	70.3	92.8
197	41	J. C. W., fat diet	91.2	96.1	96.8	67.1	91.4
199	43	....do	87.8	97.4	96.8	69.6	92.3
200	44	J. C. W., carbohydrate diet	84.5	94.0	98.6	72.5	93.3
201	45	J. C. W., fat diet	86.7	97.2	96.2	68.2	91.7
203	46	....do	89.1	96.4	97.8	70.5	92.6
204	47	J. C. W., carbohydrate diet	83.6	95.0	98.3	67.8	92.7
205	48	J. C. W., fat diet	88.2	95.6	96.6	61.9	90.9
303	49	J. C. W., carbohydrate diet	88.3	95.5	98.7	72.3	94.4
304	50	J. C. W	89.2	97.1	97.0	71.4	90.5
306	52	J. C. W., fat diet	90.6	98.2	96.7	64.6	93.5
307	53	J. C. W., carbohydrate diet	86.0	93.4	98.5	68.8	93.7
308	54-55	J. C. W., fat diet	90.4	98.0	96.5	62.8	93.2
		Average of above 15 experiments	88.4	95.8	97.5	68.3	92.5
		Average of above 21 work experiments	89.5	95.9	97.7	70.4	92.6
		Average of 32 experiments in calorimeter period	90.8	95.5	97.8	71.7	91.9
		Average of 50 experiments in preliminary and calorimeter periods	90.8	95.3	97.6	71.9	91.6

Generally speaking, the nutrients in these rations made up of ordinary food materials were quite thoroughly digested, the coefficient of digestibility of protein ranging in the different experiments from 83.6 to 96.8 per cent, and being on an average for all the experiments 90.8 per cent; that of fat ranging from 90.1 to 98.2 per cent and averaging 95.3 per cent; that of carbohydrates ranging from 93.7 to 98.9 per cent and averaging 97.6 per cent, and that of ash ranging from 44.4 to 80.4 per cent and averaging 71.9 per cent. In the case of energy the availability ranged from 88.5 to 94.4 per cent and averaged 91.6 per cent.

Some interesting deductions regarding the effect of different conditions, such as individuality, muscular activity, etc., upon the digestibility of food, may be drawn from the results of these experiments.

Individuality of subject and digestibility of food.—With each subject the range of variation in the results of similar experiments is much wider than the differences between the averages of similar experiments with different subjects, and no effect of individuality upon the digestibility of the nutrients of the diet is evident.

Effect of confinement within the calorimeter upon digestibility of food.—The averages of the results of experiments within the calorimeter are compared with those of experiments outside the calorimeter in the table below, the rest experiments and the work experiments being considered separately for the different subjects.

Table 71.—*Comparison of results of experiments during preliminary periods with those during calorimeter periods.*

Subject and character of experiment.	Protein.	Fat.	Carbohydrates.	Energy.
Rest experiments.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
E. O., preliminary period (average of 5)	92.6	94.0	97.7	90.5
E. O., calorimeter period (average of 7)	93.5	94.4	98.0	90.4
J. F. S., preliminary period (average of 2)	91.3	95.4	96.7	89.6
J. F. S., calorimeter period (average of 3)	93.1	94.9	97.8	90.7
J. C. W., preliminary period (1)	93.1	96.4	98.4	87.4
J. C. W., calorimeter period (1)	92.1	95.3	97.8	90.3
Average 8 preliminary	92.4	94.7	97.6	89.9
Average 11 calorimeter	93.2	94.6	97.9	90.5
Work experiments.				
E. O., preliminary period (average of 2)	90.1	94.2	97.7	91.3
E. O., calorimeter period (average of 2)	90.1	94.9	97.9	91.9
J. F. S., preliminary period (average of 2)	92.3	96.1	97.8	92.1
J. F. S., calorimeter period (average of 4)	93.5	96.9	98.2	93.1
J. C. W., preliminary period (average of 6)	88.2	95.8	96.9	92.3
J. C. W., calorimeter period (average of 15)	88.4	95.8	97.5	92.5
Average 10 preliminary	89.4	95.5	97.2	92.1
Average 21 calorimeter	89.5	95.9	97.7	92.6

So far as can be judged by these figures, the sojourn within the calorimeter had little influence upon the digestibility of the diet. Considering the results of the individual tests the differences between the period inside and that outside the calorimeter chamber in some cases are quite appreciable, but on the whole the differences between experiments in the different periods were no larger than between those in the same period. The averages for the preliminary and calorimeter periods for the same subject were reasonably close. In the averages of all the preliminary experiments with all these subjects and all the calorimeter experiments with all the subjects the differences are practically negligible. That is to say, there appeared to be no difference in digestibility whether the subject was confined in a small room or was free to move about without restraint.

Influence of muscular work on digestibility.—The figures in Table 70 previously given are arranged so that the results with each subject

during the different rest and work experiments may be easily compared. From these it will be observed that in some cases, with the same subject, the coefficients of digestibility were larger where the work was less in amount, and in other cases they were smaller. The differences between the experiments with different amounts of work, however, are generally no larger than those between different experiments with the same amount of exercise. The averages of different experiments of the same kind vary so little with the different subjects that all the experiments of one kind may be averaged for all the subjects together, and the averages of the different kinds of experiments may be compared as follows:

TABLE 72.—*Comparison of averages of results of experiments with different degrees of muscular activity.*

Kind of experiment.	Protein.	Fat.	Carbohydrates.	Energy.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*
Rest experiments within the calorimeter	93.2	94.6	97.9	90.5
Rest experiments outside of calorimeter	92.4	94.7	97.6	89.9
Work experiments outside of calorimeter	89.4	95.5	97.2	92.1
Work experiments within the calorimeter	89.5	95.9	97.7	92.6

These results indicate that the amount of work performed had no effect upon the digestibility of the nutrients of the diet. The average coefficients of digestibility of carbohydrates agree very closely in all four kinds of experiments; those for fat are a very little larger in the work experiments than in the rest experiments, and those for protein are quite noticeably smaller in the work experiments. The latter difference is due, however, not to the increase in the amount of work, but to a decrease in the amount of animal protein in the diet. In the majority of the work experiments the quantities of vegetable foods were increased, and the proportion of protein supplied in rather indigestible vegetable foods such as graham crackers was much larger than in the rest experiments. Because of the lower digestibility of this vegetable protein it would be expected that the coefficients found for the whole diet would be smaller than in the experiments in which the proportion of animal protein in the diet was larger. This is especially true of the larger part of the digestion experiments following No. 195. By referring to Table 70 it will be observed that these are the ones in which the coefficients of digestibility of protein are lowest.

Influence of fats v. carbohydrates upon digestibility.—As already explained, the conditions of the metabolism experiments necessitated large amounts of fats in the diet in some cases and large amounts of carbohydrates in others. This affords opportunity for comparing the relative effects of large amounts of these nutrients upon the digestibility of the diet as a whole. The following table summarizes the results of all the experiments in which the diet contained an abun-

dance of fat, and those with an abundance of carbohydrates, and for purposes of comparison the average of the results of the 18 experiments in which the quantities of fat and carbohydrates in the diet were normal.

TABLE 73.—*Comparison of the results of experiments with carbohydrate diet and with fat diet.*

Digestion experiment No.	Metabolism experiment No.	Subject and kind of experiment.	Protein.	Fat.	Carbohydrates.	Ash.	Energy.
			Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
147	P 25	J. F. S., rest, fat diet	93.9	96.8	97.7	69.8	91.7
148	25	.....do	94.4	97.4	97.4	71.4	91.1
149	P 26	.....do	88.6	94.1	95.7	44.4	87.5
150	26	.....do	92.8	97.2	97.3	66.0	90.6
156	P 32	J. F. S., work, fat diet	90.4	95.7	96.8	69.9	91.0
157	31	.....do	94.8	98.3	98.2	80.4	93.7
158	32	.....do	92.5	97.1	97.4	73.2	92.5
		Average of above 7 experiments on fat diet	92.5	96.7	97.2	67.9	91.2
194	38	J. C. W., work, fat diet	92.7	96.7	97.4	67.5	91.7
197	41	.....do	91.2	96.1	96.8	67.1	91.4
198	P 43	.....do	87.3	96.6	96.0	62.5	91.7
199	43	.....do	87.8	97.4	96.8	69.6	92.3
201	45	.....do	86.7	97.2	96.2	68.2	91.7
202	P 46	.....do	87.5	95.3	97.8	69.9	92.1
203	46	.....do	89.1	96.4	97.8	68.2	91.7
205	48	.....do	88.2	95.6	96.6	61.9	90.9
305	52	.....do	91.7	98.0	97.2	72.3	93.7
308	54-55	.....do	90.4	98.0	96.5	62.8	93.2
		Average of above 10 experiments on fat diet	89.3	96.7	96.9	67.0	92.0
		Average of all experiments on fat diet	90.6	96.7	97.0	67.4	91.7
85	24	E. O., rest, carbohydrate diet	93.3	93.7	98.5	74.0	91.8
152	28	J. F. S., rest, carbohydrate diet	92.0	90.1	98.6	69.0	90.4
153	P 29	J. F. S., work, carbohydrate diet	94.3	96.4	98.7	76.3	93.2
154	29	.....do	94.5	97.2	98.7	80.0	93.5
160	34	.....do	92.4	95.0	98.4	68.6	92.8
		Average of above 4 experiments on carbohydrate diet	93.3	94.7	98.6	73.5	92.5
192	P 37	J. C. W., work, carbohydrate diet	90.6	96.6	98.6	80.0	90.7
193	37	.....do	90.1	94.2	98.8	69.4	93.0
195	P 40	.....do	86.7	93.5	98.0	71.1	91.8
196	40	.....do	87.0	91.7	98.5	70.3	92.8
200	44	.....do	84.5	94.0	98.6	72.5	93.3
204	47	.....do	83.6	95.0	98.3	67.8	92.7
302	P 49	.....do	85.1	94.5	93.7	72.4	93.8
303	49	.....do	88.3	95.5	98.7	72.3	94.4
307	53	.....do	86.0	93.4	98.5	68.8	93.7
		Average of above 9 experiments on carbohydrate diet	86.9	94.3	98.0	71.6	92.9
		Average of all experiments on carbohydrate diet	89.1	94.3	98.2	72.3	92.7
		Average of 18 experiments on ordinary diet	92.4	94.5	97.9	77.3	90.5

It has been commonly supposed that if the quantity of any ingredient of the diet is very large the body will avail itself of a smaller proportion than if the total quantity consumed is smaller, but this opinion is not borne out by the results of the experiments summarized above.

The average coefficient of digestibility of carbohydrates is very slightly larger in the case of the diet with the larger quantity; but for practical purposes it is the same as that for the ordinary diet. In the case of fat the increase in digestibility was more marked in the case of the diet with the large quantity; that is to say, where the quantity of fat was largest in these experiments the coefficient of digestibility was greatest. The protein in the diets with the large quantities of fat and carbohydrates was less digestible than in the ordinary diet. This is due more probably to what has already been pointed out, namely, that the proportion of vegetable protein in the diet was much larger in the former experiments, than to any effect of the increase in the quantity of one nutrient in the diet upon the digestibility of the others. In fact, there does not appear to have been any such effect, for the digestibility of the fat in the ration with the large amount of carbohydrates was almost identical with that in the ordinary diet, while the digestibility of the carbohydrates was very nearly as large in the diet with the large quantities of fat as in the ordinary ration.

Average digestibility of mixed diet.—Although the number of experiments is large, there were not enough of them, nor were they made with enough different subjects, nor were there enough kinds and combinations of food materials, to warrant final conclusions as to the average amounts of nutrients digested from ordinary diet by healthy men in general; at the same time the agreement of the results with each other and with those of other experiments implies that the general average, 90.8 per cent protein, 95.3 per cent fat, and 97.6 per cent carbohydrates is not very far from an indication of the digestibility of the nutrients of mixed diet when eaten by people in good health under conditions which obtain in the United States. Accordingly it would seem that we shall not be very far out of the way in retaining the factors proposed some years ago by Atwater and Bryant[a] for the digestibility of the nutrients of a mixed diet, namely, protein, 92 per cent; fat, 95 per cent; carbohydrates, 97 per cent. These factors were based on the results of a large number of experiments, and their close agreement with the results of the experiments summarized above is an indication that they may be taken as representing very nearly the proportions which are actually digested and utilized by the body for the building of tissue and the yielding of energy.

It is to be borne in mind, however, that these factors depend considerably upon the proportions of animal and vegetable foods in the diet, as the digestibility of the nutrients is different in different materials. Thus, the protein of animal foods, like meat and milk, is more completely digested and utilized than that of most vegetable foods,

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[a] Connecticut (Storrs) Station Rpt. 1899, p. 86.

like beans or potatoes. The digestibility of the protein of a mixed diet will therefore vary according as it contains a larger or smaller proportion of animal food. Roughly speaking, however, about 95 or 96 per cent of the total organic matter and 91 or 92 per cent of the total energy of mixed diet will be digestible. To put it in another way, the body rejects about 5 per cent of the nutrients and about 9 per cent of the energy of its food.

QUANTITY AND COMPOSITION OF EXCRETA—FECES, URINE, PERSPIRATION.

Some of the more important data regarding the amount and composition of the excretory products are discussed in the following paragraphs, full data on these topics being included in the Appendix, Tables 110–116, and in previous reports.

Inquiry regarding the metabolism of matter and energy in the living organism in later years has emphasized the importance of a reasonably exact knowledge of the elementary composition of excretory products, and of the ratios of the elements to each other and to energy. The amount, elementary composition, and energy value of the urine, feces, and perspiration can be ascertained by usual laboratory methods without the use of complicated apparatus. The determination of the amount and composition of the respiratory products, or what has been often termed insensible perspiration, necessitates a respiration apparatus or some similar device; and in the same way the energy output of the body requires for its measurement some form of calorimeter, the two sorts of apparatus being conveniently combined. In many investigations of problems connected with the transformation of matter and energy in the body such forms of apparatus were not available, and therefore attempts more or less fortunate have been made to estimate the desired data regarding the respiratory products and energy and to secure such ratios of the elements to each other or to energy, that when some of the data are known the others can be readily computed by the use of assumed factors. The data most commonly used as starting points for the calculations are (1) weight of fresh or water-free substance, (2) proximate composition (total organic matter, protein, fats, and carbohydrates), (3) percentages of nitrogen, or nitrogen and carbon, as found by analyses, and (4) the amounts of energy as found by combustion with oxygen. The factors most commonly assumed for use in calculations are (1) the percentages of organic compounds, (2) the percentages of nitrogen and carbon and their ratios to each other or to other elements or to organic compounds, (3) the amounts of energy in organic (unoxidized) compounds, and (4) the ratios of nitrogen or carbon to energy. It is therefore of interest to note what the data obtained in these experiments may show as to the composition and energy of the feces and urine, the range of variation in different specimens, the factors which may be derived for use in calculations, and the probable accuracy or inaccuracy of such calculation.

Composition of urine.—Tables 113 and 114 in the Appendix give

statistics of the fresh urine and Tables 115 and 116 the composition of the water-free substance, the data of the last two tables being summarized in Tables 74 and 75 herewith.

TABLE 74.—*Average percentage composition of water and ash free substance of urine in metabolism experiments Nos. 5–55, omitting fasting experiments.*

Subject and character of experiment.	Duration.	In water and ash free substance. Nitrogen.	Carbon.	Hydrogen.	Oxygen (by difference).
	Days.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Subject E. O., average of 16 rest and work experiments	54	34.50	24.19	6.84	34.47
Subject A. W. S., average of 4 rest experiments	9	34.87	22.87	7.06	35.20
Subject J. F. S., average of 10 rest and work experiments	30	35.31	25.41	6.57	32.71
Subject J. C. W., average of 17 rest and work experiments	52	30.88	23.19	6.39	39.54
All subjects, average of 22 rest experiments	67	34.68	24.28	6.68	34.36
All subjects, average of 25 work experiments	78	32.28	23.76	6.61	37.35
All subjects, average of 47 rest and work experiments	145	33.39	24.00	6.64	35.97

TABLE 75.—*Relation of other elements to nitrogen, and of energy to organic matter, nitrogen, and carbon in urine in metabolism experiments Nos. 5–55, omitting fasting experiments.*

Subject and character of experiment.	Duration.	Amounts per gram of nitrogen. Carbon.	Hydrogen.	Oxygen (by difference).	Organic substance.	Energy per gram of— Organic substances.	Nitrogen.	Carbon.
Subject E. O.	*Days.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Calories.*	*Calories.*	*Calories.*
Average of 13 rest experiments	42	0.697	0.196	0.977	2.870	2.736	7.860	11.277
Average of 3 work experiments	12	.720	.209	1.088	3.017	2.476	7.468	10.372
Average of 16 rest and work experiments	54	.702	.199	1.002	2.903	2.678	7.774	11.074
Subject A. W. S.								
Average of 4 rest experiments	9	.657	.202	1.010	2.869	2.691	7.725	11.758
Subject J. F. S.								
Average of 4 rest experiments	12	.734	.177	.949	2.860	2.936	8.397	11.440
Average of 6 work experiments	18	.710	.193	.913	2.816	2.853	8.033	11.314
Average of 10 rest and work experiments	30	.720	.186	.928	2.834	2.887	8.179	11.360
Subject J. C. W.								
Average of 1 rest experiment	4	.744	.188	1.271	3.203	2.648	8.481	11.399
Average of 16 work experiments	48	.752	.209	1.288	3.249	2.552	8.289	11.023
Average of 17 rest and work experiments	52	.752	.208	1.286	3.246	2.560	8.307	11.047
All subjects.								
Average of 22 rest experiments	67	.701	.193	.994	2.888	2.761	7.974	11.375
Average of 25 work experiments	78	.738	.205	1.171	3.114	2.610	8.104	10.981
Average of 47 rest and work experiments	145	.721	.200	1.089	3.010	2.680	8.065	11.047

In the urine tables, the earlier analyses being known to have been somewhat inaccurate, it is not thought best to lay any great stress on the experiments prior to No. 15, or in fact on any in which E. O. was

the subject, since while in the calorimeter he could not supervise the urine analyses as usual.

The percentage composition agrees very closely in most cases, and the energy per gram of nitrogen is nearly constant. The most noticeable variation in percentage composition is seen in the case of J. C. W., where the percentage of oxygen, as estimated by difference, is very high.

The variations in the percentages of water and water-free substance in the urine of different subjects and of the same subject in different days and experiments seem considerable; but when the amount of water-free substance is taken into account the range of variation in percentages of elements and amounts of energy is rather small—less, perhaps, than might be expected. While the data are hardly sufficient, they imply as far as they go that where accuracy is essential average factors for composition of urine can not be used, but that they can be employed for approximate calculations.

Composition of feces.—Tables 110–112 of the Appendix, showing the full data regarding the amounts and composition of feces, are summarized in Tables 76 and 77 herewith.

TABLE 76.—*Average percentage composition and heat of combustion of water-free and water and ash free substance of feces in metabolism experiments Nos. 5–55, omitting fasting experiments.*

Subject and character of experiment.	Duration.	In water-free substance.						In water and ash free substance.				
		Nitrogen.	Carbon.	Hydrogen.	Oxygen (by difference).	Ash.	Energy per gram.	Nitrogen.	Carbon.	Hydrogen.	Oxygen (by difference).	Energy per gram.
Subject E. O.	*Days.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*Cals.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*Cals.*
Average of 13 rest experiments, all diets	42	5.46	48.07	6.64	20.22	19.61	5.297	6.79	59.87	8.28	25.06	6.602
Average of 3 work experiments, all diets	12	5.57	49.65	7.08	21.60	16.10	5.523	6.64	59.21	8.44	25.71	6.588
Subject A. W. S.												
Average of 4 rest experiments, special diet	9	5.89	51.27	7.03	18.70	17.11	5.735	7.11	61.86	8.48	22.55	6.920
Subject J. F. S.												
Average of 4 rest experiments, all diets	12	5.03	43.44	5.38	22.12	24.04	4.863	6.61	57.15	7.05	29.18	6.397
Average of 6 work experiments, all diets	18	4.70	46.64	6.66	21.86	20.14	5.166	5.89	58.40	8.34	27.37	6.467
Subject J. C. W.												
Average of 1 rest experiment, ordinary diet	4	5.79	47.17	6.74	22.57	17.73	5.201	7.04	57.33	8.19	27.44	6.322
Average of 6 work experiments, carbohydrate diet	22	6.39	47.88	6.71	24.56	14.46	5.154	7.49	55.99	7.81	28.71	6.026
Average of 10 work experiments, fat diet	26	4.54	51.41	7.51	17.20	19.34	5.912	5.62	63.68	9.38	21.32	7.331
All subjects.												
Maximum	......	6.97	52.74	7.89	26.20	27.25	6.238	8.02	66.66	9.75	33.12	7.690
Minimum	......	3.91	40.12	3.59	12.82	12.88	4.372	4.82	54.63	4.94	17.17	5.904
Average of 47 rest and work experiments, all diets	145	5.33	48.38	6.71	20.79	18.79	5.377	6.54	59.58	8.34	25.54	6.623

TABLE 77.—*Relation of other elements to nitrogen, and of energy to organic matter, nitrogen, and carbon, in feces in metabolism experiments Nos. 5–55, omitting fasting experiments.*

Subject and character of experiments.	Duration.	Amounts per gram of nitrogen.				Energy per gram of—		
		Carbon.	Hydrogen.	Oxygen (by difference).	Organic substance.	Organic substance.	Nitrogen.	Carbon.
Subject E. O.	*Days.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Calories.*	*Calories.*	*Calories.*
Average of 13 rest experiments, all diets	42	8.890	1.231	3.751	14.872	6.58	97.73	11.02
Average of 3 work experiments, all diets	12	8.951	1.274	3.900	15.125	6.58	99.57	11.12
Subject A. W. S.								
Average of 4 rest experiments, special diet	9	8.700	1.194	3.172	14.066	6.92	97.32	11.19
Subject J. F. S.								
Average of 4 rest experiments, all diets	12	8.694	1.080	4.426	15.200	6.41	97.40	11.19
Average of 6 work experiments, all diets	18	9.925	1.418	4.655	16.998	6.47	109.93	11.08
Subject J. C. W.								
Average of 1 rest experiment, ordinary diet	4	8.143	1.163	3.898	14.204	6.32	89.80	11.03
Average of 6 work experiments, carbohydrate diet	22	7.518	1.049	3.849	13.416	6.04	80.92	11.08
Average of 10 work experiments, fat diet	26	11.469	1.678	3.821	17.968	9.99	132.07	11.50
All subjects.								
Maximum	......	13.843	2.017	6.020	20.742	....	159.50	11.83
Minimum	......	6.816	.727	2.606	12.477	....	73.98	10.40
Average 47 experiments	145	9.229	1.294	3.927	15.450	6.67	102.73	11.14

It will be observed that in the earlier experiments with ordinary mixed diet the range of variation is much less than in the later experiments with a wider range in diet. The wide range in percentages of nitrogen and in the ratios of nitrogen to energy is very striking. On the other hand, the ratio of carbon to energy is nearly constant. Therefore, in addition to computing the energy per gram of nitrogen, the energy per gram of carbon was also computed. In the light of the results thus obtained it would appear that the nitrogen content of feces can not be accurately used as a means of determining their content of carbon or of energy, but that the carbon might serve as a very accurate basis for the calculation of the energy, provided these results are to be taken as representative. However, in the experiments with J. C. W., where the diet was abnormal, unusually large amounts of undigested fats were found in the feces during an experiment with a fat diet, which raised the energy per gram of carbon considerably. On the other hand, in the carbohydrate diet there is a decrease in the energy per gram of carbon, although its value for this class of experiments is very constant. It is also noticeable that in the experiments with J. C. W. on the carbohydrate diet there is a larger percentage of

nitrogen in the feces than with the fat diet, which would imply that excessive amounts of carbohydrates cause a larger amount of metabolic nitrogen in the feces than was the case with the fat diet.

The differences in composition of the feces are probably due to differences in both the undigested residues of food and the amounts of digestive juices poured into the alimentary canal. Such differences might be expected with so much range in the composition of the diet, especially when the carbohydrates and fat were consumed in large amounts.

How much narrower the range in composition of the feces would be with different persons on ordinary diet we have no means of judging, but if these experiments may be taken as at all indicative it would seem that the composition and heat of combustion of a given specimen of feces can not well be computed on the basis of its content of either water-free substance or organic matter or nitrogen, but that the carbon content does give an approximate means of judging of its energy.

Accuracy of the figures for composition of food, feces, and urine.—Much attention has been given in this laboratory to special studies of analytical methods, as explained on pages 41–43 and elsewhere, and every precaution has been taken to secure accuracy in all the figures in the tables. The determinations of nitrogen, carbon, and hydrogen are believed to be close approximations of the truth. The figures for water-free substance are those obtained by drying in the usual way; sometimes they may be made too large by small amounts of moisture which were not expelled, or too small by incipient decomposition in the heating, but the errors from either source are not believed to be very considerable. The figures for ash represent the results of incineration and include considerable carbon, and especially oxygen as carbonates, sulphates, and phosphates. The determinations of organic matter are, of course, affected by errors in the water-free substance and ash, as well as by the presence of the carbon and oxygen in the ash that has come from the organic matter of the fresh material. The estimates of "oxygen by difference" are at best crude, but are of interest for purposes of comparison. The figures for energy represent the heats of combustion as determined with the bomb calorimeter. In the case of feces these results are accurate, but urine is so liable to decomposition with loss of energy not only in the process of drying, but also on standing at ordinary temperature and atmospheric pressure, even in the presence of preservatives, that the accuracy of the determinations is somewhat less certain. When the earlier determinations of heats of combustion of urine were made the danger of loss of energy in these ways could not be foreseen, and some of them are now regarded as of doubtful value. In experiments Nos. 1–15, furthermore, less attention was paid to proper care of the urine than later, and accordingly less stress is laid on the analyses of the urine of these experiments in the

summing up of the results. The errors noted in the above discussion are such as are common to all investigations like these and are not peculiar to the experiments here reported. They should be mentioned, however, in a detailed discussion of the subject.

Nitrogen in perspiration.—Table 78 shows the amounts of nitrogen eliminated in the perspiration in a number of work experiments as determined by the method described on pages 52, 53.

TABLE 78.—*Nitrogen eliminated in perspiration in work experiments.*

	Duration.	Total nitrogen.	Average per day.		Duration.	Total nitrogen.	Average per day.
	Days.	*Grams.*	*Grams.*		*Days.*	*Grams.*	*Grams.*
Experiment No. 6	4	0.88	0.22	Experiment Nos. 43–45	9	3.16	0.35
Experiment No. 11	4	.79	.20	Experiment Nos. 46–48	9	1.99	.22
Experiment No. 12	4	.96	.24	Experiment Nos. 49–50	[a]3⅝	2.39	.66
Experiment Nos. 29–31	9	1.78	.20	Experiment Nos. 52–55	[b]11	5.31	.48
Experiment Nos. 32–34	9	3.58	.40	Total	88⅝	25.65	
Experiment Nos. 37–38	8	2.69	.34				
Experiment Nos. 40–41	8	2.12	.27	Average per day		.29	

[a] Experiment No. 50 counted as five-eighths of a day as regards the elimination of perspiration, since the subject worked only five hours.

[b] Experiment No. 55 counted as two days as regards the elimination of perspiration, since the subject worked sixteen hours.

The amount of nitrogen eliminated in the perspiration during these work experiments certainly is far in excess of that commonly considered to be excreted in such cases. Reliable data on this point are not numerous and much yet remains to be done.

W. Camerer[a] reports the composition of perspiration induced in a young man by different sorts of warm baths. In the average of four determinations 100 cubic centimeters of perspiration contained 0.17 gram of nitrogen. The urea determined in two of the samples averaged 0.04 gram. Schäfer[b] cites various determinations of the quantity of urea and nitrogen excreted in the water of perspiration. Thus Favre found 0.044 gram urea per 1,000 cubic centimeters of perspiration, and Funke 1.55 grams urea in 1,000 cubic centimeters of perspiration. Argutinsky found 0.363 and 0.410 gram of urea in 225 and 230 cubic centimeters of perspiration, respectively. The same investigator also found 0.7 gram of nitrogen by extracting with distilled water the clothes worn by subjects actively walking or climbing a hill during a considerable portion of the day. C. C. Esterbrook[c] concluded, in some experiments upon himself, that the perspiration contained 0.1 to 0.3 per cent urea.

A still more pronounced elimination of nitrogen in the perspiration

[a] Ztschr. Biol., **41** (1901), p. 271.

[b] Textbook of Physiology, Vol. I, 1898, pp. 671–673.

[c] Scottish Med. and Surg. Jour., 6 (1900), p. 120.

was found by Eijkmann[a] in three experiments with Malay medical students in the tropical climate of Java. The first experiment lasted three hours, during which 0.222 gram of nitrogen was excreted. The second experiment continued twenty-four hours, during which time there was found in the perspiration 0.761 gram of nitrogen. The third experiment likewise continued twenty-four hours, and there was an elimination of nitrogen in the perspiration amounting to 1.362 grams. The subjects were engaged in light work.

It will be noticed that the largest quantity of nitrogen excreted in the perspiration in any of the instances above cited was with men with light bodily exercise in the very warm climate of Java. This was estimated at from 0.8 to 1.4 grams per day.

In Table 78, showing the amount of perspiration obtained in the respiration calorimeter experiments, it is seen that the quantity of nitrogen thus eliminated rose to 0.66 gram, or the equivalent of 4.12 grams of protein, per day. There is reason to believe that these figures represent a minimum rather than a maximum result, for the urea continually undergoes decomposition with loss of ammonia. Certainly the loss of nitrogen through this channel can not be neglected in metabolism experiments, for a gain or loss of a few tenths of a gram of nitrogen has frequently been considered the basis for broad generalizations regarding the properties of nutrients, but since no constant factor appears in the table, further discussion is not thought desirable at this time.

SUMMARY OF DATA OF INCOME AND OUTGO OF INDIVIDUAL EXPERIMENTS.

Table 79 shows in detail the balance of income and outgo of nitrogen, carbon, and energy as well as computed gains or losses of body protein and fat in experiments Nos. 5–55. Inasmuch as the data here summarized are taken into account in the discussion of some of the topics considered in these pages, no special discussion of them in this table is given here.

[a] Arch. Path. Anat. u. Physiol. [Virchow] **131**, p. 170. Abs. in U. S. Dept. Agr., Office of Experiment Stations Bul. 45, p. 64.

TABLE 79.—*Summary of income and outgo of nitrogen, carbon,*

Serial No.	Subject and kind of experiment.	Duration.	Nitrogen. (a) In food.	(b) In feces.	(c) In urine.	(d) Gain (+) or loss (−), $a-(b+c)$.	Carbon. (e) In food.	(f) In feces.	(g) In urine.	(h) In respiratory products.	(i) Gain (+) or loss (−), $e-(f+g+h)$.
	Rest experiments.	*Days.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*
5	Subject E. O.	4	19.1	1.7	18.1	− 0.7	248.9	13.8	11.6	231.7	− 8.2
7	....do	4	16.7	.9	17.7	− 1.9	216.9	6.6	13.3	214.5	− 17.4
8	....do	4	20.8	1.3	19.5	0.0	270.7	10.6	13.9	224.5	+ 21.7
9	....do	4	19.1	1.3	18.4	− .6	261.6	13.4	12.6	223.6	+ 12.0
10	....do	4	19.8	1.4	19.5	− 1.1	252.8	11.8	13.5	215.0	+ 12.4
13	....do	3	18.7	1.1	19.5	− 1.9	245.8	11.1	15.1	205.2	+ 14.4
14	....do	4	15.1	.9	16.2	− 2.0	239.0	7.4	12.2	207.3	+ 12.2
15	....do	2	17.4	.9	15.6	+ .9	244.9	7.8	11.0	220.1	+ 6.0
16	....do	2	17.4	.8	15.5	+ 1.1	244.6	7.8	10.9	218.3	+ 7.6
17	....do	2	17.4	.8	15.6	+ 1.0	244.8	7.8	11.0	217.6	+ 8.4
22	....do	3	19.8	1.1	18.5	+ .2	278.7	10.2	11.8	207.9	+ 48.7
23	....do	3	19.8	1.1	19.0	− .3	244.9	10.2	12.2	216.4	+ 6.1
24	....do	3	19.8	1.3	18.2	+ .3	299.7	10.5	11.8	230.9	+ 46.6
	Average 13 experiments with E. O.	42	18.5	1.1	17.8	− .4	253.3	9.9	12.4	217.9	+ 13.1
18	Subject A. W. S.	2	15.5	1.0	16.4	− 1.9	252.0	9.0	10.4	219.3	+ 13.3
19	....do	2	15.5	1.0	14.5	0.0	252.2	9.0	9.2	206.6	+ 27.4
20	....do	2	15.5	1.0	14.1	+ .4	252.0	9.0	9.0	216.2	+ 17.8
21	....do	3	15.5	1.0	15.4	− .9	215.2	9.0	10.8	217.4	− 22.0
	Average 4 experiments with A. W. S.	9	15.5	1.0	15.1	− .6	242.9	9.0	9.9	214.9	+ 9.1
25	Subject J. F. S.	3	17.7	1.0	16.4	+ .3	270.9	9.7	12.8	216.6	+ 31.8
26	....do	3	15.9	1.1	15.3	− .5	233.2	9.4	11.0	196.1	+ 16.7
27	....do	3	15.8	1.1	15.7	− 1.0	229.0	8.9	11.2	198.3	+ 10.6
28	....do	3	15.8	1.2	15.3	− .7	245.8	10.0	10.9	210.7	+ 14.2
	Average 4 experiments with J. F. S.	12	16.3	1.1	15.7	− .5	244.7	9.5	11.5	205.4	+ 18.3
35	Subject J. C. W	4	16.0	1.2	15.8	− 1.0	236.1	10.0	11.8	221.5	− 7.2
	Average 22 rest experiments with E. O., A. W. S., J. F. S., and J. C. W.	67	17.4	1.1	16.8	− .5	249.1	9.7	11.7	215.3	+ 12.4
	Fasting experiments.										
36	Subject J. C. W	1	0.0	0.0	11.5	−11.5	0.0	0.0	8.6	193.9	−202.5
39	....do	1	0.0	0.0	16.0	−16.0	0.0	0.0	12.2	177.0	−189.2
42	....do	1	0.0	0.0	14.1	−14.1	0.0	0.0	10.3	169.0	−179.3
51	....do	2	{ 0.0	0.0	11.7	−11.7	0.0	0.0	9.3	191.6	−200.9
			0.0	0.0	12.2	−12.2	0.0	0.0	9.3	190.4	−199.7
	Average 4 experiments with J. C. W.	5	0.0	0.0	13.1	−13.1	0.0	0.0	9.9	184.4	−194.3

hydrogen, and energy in 51 metabolism experiments, covering 150 days.

Hydrogen.					Body material.		Energy.									
(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)	(s)	(t)	(u)	(v)	(w)	(x)	(y)		
In food.	In feces.	In urine.	In water apparently lost.	Gain (+) or loss (−), $k-(l+m+n)$.	Protein gained (+) or lost (−).	Fat gained (+) or lost (−).	Of food.	Of feces.	Of urine.	Of body protein gained (+) or lost (−).	Of body fat gained (+) or lost (−).	Of material actually oxidized; net income $r-(s+t+u+v)$.	Measured as heat; net outgo.	Difference between net income and net outgo.		Serial No.
Gms.	*Gms.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*	*Cals.*	*Cals.*	*Cals.*	*Cals.*	*Cals.*	*Cals.*	*Cals.*	*Cals.*	*Pr. ct.*	
36.4	1.9	3.7	51.4	− 20.5	− 4.2	− 7.8	2,655	143	128	− 24	− 74	2,482	2,379	−103	−4.2	5
35.9	.9	3.6	48.7	− 17.3	− 12.0	− 14.5	2,441	76	134	− 68	− 138	2,437	2,394	− 43	−1.7	7
39.2	1.5	4.0	67.5	− 33.7	0.0	+ 28.5	2,897	117	153	0	+ 266	2,356	2,286	− 70	−3.0	8
38.1	1.9	3.4	39.8	− 6.9	− 3.6	+ 18.3	2,717	142	149	− 20	+ 174	2,272	2,309	+ 37	+1.6	9
41.2	1.6	3.2	36.5	− .1	− 6.7	+ 21.0	2,701	127	147	− 38	+ 200	2,265	2,283	+ 18	+ .8	10
36.6	1.6	4.3	58.7	− 28.0	− 11.7	+ 27.1	2,596	125	173	− 66	+ 258	2,106	2,151	+ 45	+2.1	13
36.2	1.0	3.5	26.6	+ 5.1	− 12.2	+ 24.5	2,513	82	142	− 69	+ 234	2,124	2,193	+ 69	+3.2	14
40.6	1.1	3.1	34.3	+ 2.2	+ 5.6	+ 3.9	2,642	88	128	+ 31	+ 37	2,358	2,362	+ 4	+ .2	15
40.6	1.1	3.1	36.1	+ .3	+ 6.9	+ 5.3	2,638	88	126	+ 39	+ 50	2,335	2,332	− 3	− .1	16
40.6	1.1	3.1	46.1	− 9.7	+ 5.8	+ 11.0	2,643	88	128	+ 34	+ 105	2,288	2,276	− 12	− .5	17
44.4	1.4	3.5	28.8	+ 10.7	+ 1.2	+ 63.1	3,029	114	138	+ 7	+ 602	2,168	2,259	+ 91	+4.2	22
35.4	1.5	3.5	41.4	− 11.0	− 1.7	+ 9.1	2,546	114	141	− 9	+ 87	2,213	2,176	− 37	−1.7	23
43.8	1.5	3.4	27.9	+ 11.0	+ 1.7	+ 60.1	3,061	116	136	+ 9	+ 573	2,227	2,272	+ 45	+2.0	24
39.2	1.4	3.5	41.8	− 7.5	− 2.4	+ 19.2	2,698	109	140	− 13	+ 183	2,279	2,283	+ 3	+ .2	
41.1	1.2	3.3	28.5	+ 8.1	− 11.9	+ 25.6	2,762	100	123	− 67	+ 244	2,362	2,488	+126	+5.3	18
41.1	1.2	3.0	17.4	+ 19.5	+ .3	+ 35.8	2,765	101	108	+ 1	+ 341	2,214	2,279	+ 65	+2.9	19
41.1	1.2	2.9	42.4	− 5.4	+ 2.2	+ 21.9	2,763	101	106	+ 12	+ 209	2,335	2,303	− 32	−1.4	20
31.8	1.2	3.1	41.4	− 13.9	− 5.4	− 25.2	2,264	101	126	− 31	− 240	2,308	2,279	− 29	−1.3	21
38.8	1.2	3.1	32.4	+ 2.1	− 3.7	+ 14.5	2,639	101	116	− 21	+ 139	2,305	2,337	+ 32	+1.4	
39.7	1.4	3.1	13.2	+ 21.9	+ 1.9	+ 40.5	2,896	111	147	+ 11	+ 386	2,241	2,244	+ 3	+ .1	25
33.9	1.1	2.7	36.5	− 6.4	− 3.3	+ 24.2	2,490	106	128	− 19	+ 232	2,043	2,085	+ 42	+2.0	26
37.0	.8	2.7	42.6	− 9.2	− 6.0	+ 18.1	2,485	97	124	− 34	+ 173	2,125	2,123	− 2	− .1	27
35.8	1.3	2.7	21.4	+ 10.4	− 4.6	+ 21.9	2,489	112	128	− 26	+ 209	2,066	2,079	+ 13	+ .6	28
36.6	1.2	2.8	28.4	+ 4.2	− 3.0	+ 26.2	2,590	107	132	− 17	+ 250	2,119	2,133	+ 14	+ .7	
34.8	1.4	3.0	44.5	− 14.1	− 6.4	− 5.0	2,519	110	135	− 36	− 47	2,357	2,397	+ 40	+1.7	35
38.4	1.3	3.3	37.8	− 4.0	− 2.9	+ 18.5	2,659	107	134	− 16	+ 176	2,258	2,270	+ 12	+ .6	
0.0	0.0	2.2	125.0	−127.2	− 71.9	−216.1	0	0	95	−406	−2,062	2,373	2,253	−120	−5.1	36
0.0	0.0	3.1	13.4	− 16.5	−100.0	−179.0	0	0	131	−565	−1,708	2,142	2,027	−115	−5.4	39
0.0	0.0	2.8	125.4	−128.2	− 88.1	−174.3	0	0	108	−498	−1,663	2,053	1,946	−107	−5.2	42
0.0	0.0	2.6	137.7	−140.3	− 73.3	−213.1	0	0	97	−414	−2,033	2,350	2,362	+ 12	+ .5	51
0.0	0.0	2.7	89.9	− 92.6	− 76.6	−209.1	0	0	94	−433	−1,995	2,334	2,348	+ 14	+ .6	
0.0	0.0	2.7	98.3	−101.0	− 82.0	−198.3	0	0	105	−463	−1,892	2,250	2,187	− 63	−2.9	

TABLE 79.—*Summary of income and outgo of nitrogen, carbon,*

Serial No.	Subject and kind of experiment.	Duration.	Nitrogen. (a) In food.	(b) In feces.	(c) In urine.	(d) Gain (+) or loss (−), $a-(b+c)$.	Carbon. (e) In food.	(f) In feces	(g) In urine.	(h) In respiratory products.	(i) Gain (+) or loss (−), $e-(f+g+h)$.
	Work experiments.	*Days.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*
6	Subject E. O	4	19.1	1.5	16.5	+ 1.1	336.7	12.4	12.5	345.2	− 33.4
11	....do	4	19.8	2.2	18.1	− .5	373.5	20.2	12.8	372.6	− 32.1
12	....do	4	19.3	1.3	18.2	− .2	344.0	12.1	12.4	344.7	− 25.2
	Average 3 experiments with E. O.	12	19.4	1.7	17.6	+ .1	351.4	14.9	12.6	354.1	− 30.2
29	Subject J. F. S	3	16.0	.8	16.0	− .8	333.6	8.3	11.3	334.9	− 20.9
30	....do	3	15.9	.7	17.3	− 2.1	315.1	6.5	12.2	316.5	− 20.1
31	....do	3	16.1	.8	15.6	− .3	321.5	8.1	11.0	315.8	− 13.4
32	....do	3	16.1	1.2	15.7	− .8	320.0	12.6	11.1	325.6	− 29.4
33	....do	3	16.0	1.2	17.3	− 2.5	319.2	11.4	12.3	333.3	− 37.8
34	....do	3	16.0	1.2	16.7	− 1.8	335.7	11.6	11.8	345.4	− 33.1
	Average 6 experiments with J. F. S.	18	16.0	1.0	16.4	− 1.4	324.2	9.8	11.6	328.6	− 25.8
37	Subject J. C. W	4	16.8	1.6	16.9	− 1.7	366.3	11.7	12.8	451.5	−109.7
38	....do	4	16.9	1.2	20.6	− 4.9	335.1	13.5	15.6	401.9	− 96.0
40	....do	4	17.1	2.2	17.1	− 2.2	447.0	16.6	12.4	504.5	− 86.5
41	....do	4	16.9	1.5	20.3	− 4.9	401.6	19.6	14.7	461.8	− 94.4
43	....do	4	17.1	2.0	19.1	− 4.0	431.1	19.8	13.8	452.0	− 54.6
44	....do	4	17.8	2.6	17.3	− 2.1	491.8	17.5	12.5	504.6	− 42.8
45	....do	1	17.4	2.2	19.3	− 4.1	436.2	22.2	13.8	466.3	− 66.1
46	....do	4	17.0	1.8	16.1	− .9	434.0	18.9	12.3	460.3	− 57.5
47	....do	4	17.4	2.7	16.3	− 1.6	469.3	18.7	12.5	503.3	− 65.1
48	....do	1	17.0	2.0	17.4	− 2.4	445.4	24.3	13.3	479.4	− 71.6
49	....do	3	18.7	2.1	16.1	+ .5	546.7	16.5	12.5	509.1	+ 8.5
52	....do	3	17.7	1.6	16.4	− .3	486.7	19.8	12.2	470.0	− 15.3
53	....do	3	17.9	2.3	15.4	+ .2	547.7	20.2	11.4	513.7	+ 2.4
54	....do	3	18.3	1.7	17.1	− .5	495.4	20.9	12.7	479.1	− 17.3
	Average 14 experiments with J. C. W.	46	17.4	2.0	17.5	− 2.1	452.4	18.6	13.0	475.5	− 54.7
	Average 23 work experiments with E. O., J. F. S., and J. C. W.	76	17.3	1.7	17.2	− 1.6	405.8	15.8	12.6	421.4	− 44.0
	Work experiments under exceptional conditions.										
50	Subject J. C. W	1	11.1	1.2	13.9	− 4.0	236.3	11.1	10.9	374.9	−160.6
55	....do	1	18.4	1.7	18.3	− 1.6	484.7	20.9	13.5	838.3	−388.0
	Average 25 work experiments with E. O., J. F. S., and J. C. W.	78	17.1	1.7	17.1	− 1.7	402.2	15.8	12.6	436.2	− 62.4
	Average 47 rest and work experiments with E. O., A. W. S., J. F. S., and J. C. W.	145	17.3	1.6	17.3	− 1.6	330.6	12.9	12.1	332.8	− 27.2

hydrogen, and energy in 51 metabolism experiments, covering 150 days—Continued.

Hydrogen.					Body material.		Energy.									
(*k*)	(*l*)	(*m*)	(*n*)	(*o*)	(*p*)	(*q*)	(*r*)	(*s*)	(*t*)	(*u*)	(*v*)	(*w*)	(*x*)	(*y*)		
In food.	In feces.	In urine.	In water apparently lost.	Gain (+) or loss (−), $k-(l+m+n)$.	Protein gained (+) or lost (−).	Fat gained (+) or lost (−).	Of food.	Of feces.	Of urine.	Of body protein gained (+) or lost (−).	Of body fat gained (+) or lost (−).	Of material actually oxidized; net income $r-(s+t+u+v)$.	Measured as heat; net outgo.	Difference between net income and net outgo.		Serial No.
Gms.	*Gms.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*	*Cals.*	*Cals.*	*Cals.*	*Cals.*	*Cals.*	*Cals.*	*Cals.*	*Cals.*	*Pr. ct.*	
51.2	1.8	3.9	53.0	− 7.5	+ 6.9	− 48.7	3,678	139	125	+ 39	− 464	3,839	3,726	−113	−2.9	6
55.7	2.8	3.7	82.7	− 33.5	− 3.0	− 40.1	3,862	219	133	− 17	− 382	3,909	3,931	+ 22	+ .6	11
55.4	1.7	3.4	58.9	− 8.6	− 1.0	− 32.5	3,881	136	130	− 5	− 309	3,928	3,927	− 1	0.0	12
54.1	2.1	3.7	64.8	− 16.5	+ 1.0	− 40.4	3,807	165	129	+ 6	− 385	3,892	3,861	− 31	− .8	
50.5	1.2	3.0	24.6	+ 21.6	− 5.0	− 23.9	3,487	93	134	− 28	− 229	3,517	3,589	+ 72	+2.1	29
51.0	.9	3.2	57.2	− 10.3	−13.1	− 17.2	3,453	71	140	− 74	− 164	3,480	3,470	− 10	− .3	30
48.8	1.1	2.9	29.5	+ 15.3	− 2.3	− 16.0	3,495	91	129	− 13	− 153	3,441	3,420	− 21	− .6	31
49.0	1.8	3.0	71.1	− 26.9	− 5.0	− 35.1	3,487	142	119	− 28	− 336	3,590	3,565	− 25	− .7	32
52.5	1.7	3.3	59.0	− 11.5	−15.4	− 38.9	3,481	125	129	− 87	− 371	3,685	3,632	− 53	−1.4	33
51.1	1.7	3.2	52.9	− 6.7	−11.4	− 35.5	3,493	126	126	− 65	− 338	3,644	3,587	− 57	−1.6	34
50.5	1.4	3.1	49.1	− 3.1	− 8.7	− 27.8	3,483	108	130	− 49	− 265	3,559	3,544	− 15	− .4	
54.0	1.6	3.2	103.8	− 54.6	−10.8	−136.7	3,715	126	133	− 61	−1,304	4,821	4,764	− 57	−1.2	37
50.4	2.0	3.9	74.0	− 29.5	−30.5	−104.9	3,708	153	155	−172	−1,001	4,573	4,477	− 96	−2.1	38
67.1	2.4	3.3	72.0	− 10.6	−13.6	−104.2	4,505	182	143	− 77	− 994	5,251	5,223	− 28	− .5	40
62.1	2.9	4.0	75.0	− 19.8	−30.6	−102.8	4,539	231	158	−173	− 981	5,304	5,242	− 62	−1.2	41
67.7	2.9	3.6	65.4	− 4.2	−25.0	− 54.3	4,867	224	147	−141	− 518	5,155	5,205	+ 50	+1.0	43
74.8	2.4	3.3	63.2	+ 5.9	−13.1	− 47.1	4,932	190	140	− 74	− 449	5,125	5,198	+ 73	+1.4	44
67.9	3.2	3.6	94.5	− 33.4	−25.6	− 69.0	4,860	256	150	−145	− 658	5,257	5,162	− 95	−1.8	45
59.9	2.7	3.5	62.6	− 8.9	− 5.6	− 71.6	4,836	214	144	− 32	− 683	5,193	5,238	+ 45	+ .8	46
69.6	2.6	3.5	77.4	− 14.0	−10.1	− 78.5	4,710	199	145	− 58	− 749	5,173	5,248	+ 75	+1.4	47
59.4	3.5	3.8	67.9	− 15.8	−15.0	− 83.6	4,856	280	162	− 85	− 798	5,297	5,218	− 79	−1.5	48
82.1	2.3	3.5	61.0	+ 15.3	+ 2.9	+ 9.2	5,499	172	135	+ 16	+ 88	5,088	5,245	+157	+3.1	49
74.1	2.9	3.7	69.5	− 2.0	− 2.1	− 18.6	5,476	228	128	− 12	− 177	5,309	5,277	− 32	− .6	52
82.8	2.8	3.5	43.3	+ 33.2	+ 1.3	+ 2.1	5,478	218	128	+ 8	+ 20	5,104	5,178	+ 74	+1.4	53
75.5	3.1	3.9	96.2	− 27.7	− 3.3	− 20.5	5,513	242	132	− 19	− 196	5,354	5,215	−139	−2.6	54
67.7	2.7	3.6	73.3	− 11.9	−12.9	− 62.9	4,821	208	143	− 73	− 600	5,143	5,135	− 8	− .2	
61.4	2.3	3.5	65.9	− 10.2	−10.0	− 50.8	4,340	176	138	− 57	− 484	4,567	4,554	− 13	− .3	
35.8	1.6	3.1	119.0	− 87.9	−25.2	−193.6	2,601	128	118	−142	−1,847	4,344	4,134	−210	−4.8	50
73.9	3.0	4.1	301.2	−234.4	−10.0	−503.1	5,514	243	145	− 56	−4,799	9,981	9,314	−667	−6.7	55
60.9	2.3	3.5	77.4	− 22.3	−10.6	− 74.6	4,317	177	137	− 60	− 712	4,775	4,728	− 47	− .8	
50.4	1.8	3.4	58.9	− 13.7	− 7.0	− 31.0	3,541	144	136	− 40	− 296	3,597	3,577	− 20	− .6	

DEMAND OF THE BODY FOR NOURISHMENT—DIETARY STANDARDS.

One of the objects of these experiments is to accumulate information regarding the demands of the body for food with different persons and under different conditions of rest and work, and data bearing upon these questions are found in them all. The detailed tables of the Appendix (Nos. 110–116) show the total amounts and the composition of the food, drink, and excretory products. The figures in Table 80 summarize very briefly some of the principal results.

TABLE 80.—*Income and outgo of material and energy, and gains or losses of protein and fat—Amounts per day.*

Subject, duration, and character of experiments.	Nitrogen.	Carbon.	Energy.	Protein (N×6.25).	Fat.
Rest experiments.					
E. O., 13 experiments, 42 days, average:	*Grams.*	*Grams.*	*Calories.*	*Grams.*	*Grams.*
In digested food	17.4	230.5	2,443	108.8	....
In material oxidized	18.0	217.9	2,282	112.5	....
Gain (+) or loss (−) in body	− 0.6	+ 12.6	....	− 3.7	+19.0
A. W. S., 4 experiments, 9 days, average:					
In digested food	14.5	220.5	2,375	90.6	....
In material oxidized	15.1	214.8	2,305	94.4	....
Gain (+) or loss (−) in body	− 0.6	+ 5.7	....	− 3.8	+10.1
J. F. S., 4 experiments, 12 days, average:					
In digested food	15.2	223.7	2,352	95.0	....
In material oxidized	15.7	205.4	2,119	98.1	....
Gain (+) or loss (−) in body	− 0.5	+ 18.3	....	− 3.1	+26.2
J. C. W., 1 experiment, 4 days, average:					
In digested food	14.8	214.3	2,274	92.5	....
In material oxidized	15.8	221.5	2,357	98.8	....
Gain (+) or loss (−) in body	− 1.0	− 7.2	....	− 6.3	− 5.0
E. O., A. W. S., J. F. S., J. C. W., 22 experiments, average:					
In digested food	16.5	227.0	2,408	103.1	....
In material oxidized	17.1	215.5	2,260	106.9	....
Gain (+) or loss (−) in body	− 0.6	− 11.5	....	− 3.8	+17.7
Work experiments.					
E. O., 3 experiments, 12 days, average:					
In digested food	17.7	324.0	3,513	110.6	....
In material oxidized	17.6	354.2	3,892	110.0	....
Gain (+) or loss (−) in body	+ 0.1	− 30.2	....	+ 0.6	−40.4
J. F. S., 6 experiments, 18 days, average:					
In digested food	15.0	302.9	3,245	93.7	....
In material oxidized	16.4	328.7	3,560	102.5	....
Gain (+) or loss (−) in body	− 1.4	− 25.8	....	− 8.8	−27.8
J. C. W., 14 experiments, 46 days, average:					
In digested food	15.4	417.2	4,416	96.3	....
In material oxidized	17.5	474.4	5,120	109.4	....
Gain (+) or loss (−) in body	− 2.1	− 57.2	....	− 13.1	−66.0
E. O., J. F. S., J. C. W., 23 experiments, 76 days, average:					
In digested food	15.7	375.4	3,996	98.1	....
In material oxidized	17.3	420.9	4,556	108.1	....
Gain (+) or loss (−) in body	− 1.6	− 45.5	....	− 10.0	−52.9

By "digestible food" or "digested food" referred to in the above table is understood, as explained earlier, the total food less the feces—in other words, the sum of the nutrients which the body utilizes for the building of tissue and the production of energy. No correction is introduced for metabolic products in the feces, since these were derived originally from the food (or body tissue), and are a necessary accompaniment of undigested material. The available energy of the food is the total heat of combustion of the food minus the heat of combustion of the unoxidized materials of feces and urine. No further correction for the labor of chewing and digesting is included. It is assumed that the quantity of carbohydrates in the body is the same at the beginning as at the end of the experiment. The gains and losses of body protein and body fat are computed from the gains and losses of the nitrogen and carbon by the method previously described.[a] Accordingly the figures show the average daily amounts of digestible protein and available energy supplied by the food and the amounts actually used by the body when the subject had a minimum amount of exercise and when he was engaged in decidedly active muscular work.

The materials actually oxidized in the body are the digested nutrients of the food, minus the protein or fat gained or plus the protein or fat lost by the body. The data thus show very clearly the demands of the body for nutritive material under the different conditions and the increase in the demand which accompanied the performance of muscular work.

These experiments simply show the quantities of material and energy metabolized by a small number of men under specific conditions of work and rest. The bearing of these data upon the general subject of dietary standards can be more advantageously discussed when it is possible to take into account not only these and other experiments with men in the respiration calorimeter, but also a large number of experimental inquiries and observation of dietary usage of people of different classes and occupations in different countries.

There is no doubt that in many cases the body can be maintained in nitrogen and carbon equilibrium with much smaller quantities of nitrogen and energy than those actually used by any of the men in these experiments. It is equally certain that in other cases the requirements are much larger. The tentative standards for daily diet which have been proposed by a number of investigators have served a useful purpose, but they will doubtless have to be modified as the fundamental data become more exact and numerous.

One principle which thus far has not received adequate recognition in dietary standards may perhaps be expressed by saying that the standard must vary not only with the conditions of activity and envi-

[a] U. S. Dept. Agr., Office of Experiment Stations Bul. 69, p. 44.

ronment, but also with the nutritive plane at which the body is to be maintained. A man may live and work and maintain bodily equilibrium on either a higher or lower nitrogen level or energy level, but the essential question is, What level is most advantageous? The answer to this must be sought not simply in metabolism experiments and dietary studies, but also in broader observations regarding bodily and mental efficiency and general health, strength, and welfare. This question is discussed in more detail elsewhere.[a]

These experiments show the exact quantities of protein and energy katabolized in the bodies of young, healthy, active men under different conditions of food and fasting, work and rest.

Table 81 shows the quantities of protein and energy supplied per person per day, and calculated values for the corresponding quantities supplied per kilogram of body weight and square meter of body surface.

TABLE 81.—*Protein and energy katabolized daily per person, per kilogram of body weight and per square meter of body surface in experiments Nos. 5–55.*

Subject and kind of experiment.	Number of experiment.	Duration.	Energy of external muscular work.	In material oxidized.					
				Per person.		Per kilogram of body weight.		Per square meter of body surface.	
				Protein (N×6.25).	Energy.	Protein (N×6.25).	Energy.	Protein (N×6.25).	Energy.
Rest, fasting:		*Days.*	*Calories.*	*Grams.*	*Calories.*	*Grams.*	*Calories.*	*Grams.*	*Calories.*
J. C. W., average	4	5	....	82.0	2,250	1.08	29.6	37.1	1,018
Rest, food generally sufficient for maintenance:									
E. O., average	13	42	....	112.5	2,282	1.61	32.6	53.8	1,092
A. W. S., average	4	9	....	94.4	2,305	1.35	32.9	45,2	1,103
J. F. S., average	4	12	....	98.1	2,119	1.51	32.6	49.3	1,065
J. C. W., average	1	4	....	98.8	2,357	1.30	31.0	44,7	1,067
Average of all	22	67	....	106.9	2,260	1.54	32.5	51.4	1,087
Work, 8 hours, food generally not quite sufficient for maintenance:									
E. O., average	3	12	214	110.0	3,892	1.57	55.6	52.6	1,863
J. F. S., average	6	18	233	102.5	3,560	1.58	54.8	51.5	1,789
J. C. W., average	14	46	546	109.4	5,120	1.44	67.8	49.5	2,317
Average of all	23	76	419	108.1	4,556	1.49	62.9	50.5	2,129
Work, 16 hours, food insufficient for maintenance:									
J. C. W	1	1	1,482	114.4	9,981	1.51	131.3	51.8	4,526

The results may be considered with relation to the quantities of total food, protein, and energy katabolized under the different conditions.

[a] Connecticut (Storrs) Station Rpt. 1902, p. 123.

The quantities of total food in all the experiments, except the earlier ones with E. O. and those with O. F. T., were rather small, the idea being that the body would utilize its food more economically with a limited than with an excessive supply. In the rest experiments the food was nearly or quite sufficient to maintain nitrogen and carbon equilibrium during the periods of the metabolism experiments.

In the work experiments the supply was generally not quite sufficient for maintenance, and in some of the experiments, especially those with J. C. W., it fell considerably short of meeting the demand. The drafts upon body material, as shown in Table 79, indicate the extent to which the demand for metabolizable material exceeded the supply in the food.

The supply of protein in the earlier experiments with E. O. and O. F. T., and indeed in the rest experiments with A. W. S. and J. C. W. also, was intended to approach more or less nearly to the quantity to which the subjects were ordinarily accustomed, though in every case it was purposely made small rather than large. The period of the preliminary digestion experiment, which preceded the metabolism experiment, was depended upon to bring the body into approximate nitrogen equilibrium in the rest experiments and in some of the earlier work experiments. In the later work experiments, especially those with J. C. W., the quantity of protein was intended to be a little less than needed for nitrogen equilibrium. The reason for making the supply of protein so small is found in one of the purposes of the experiments, which was to compare the relative efficiency of the nonnitrogenous materials of the ration. It was thought that the action of these latter might perhaps be partially obscured with an abundant supply of protein. It was with this same general idea that the whole food supply was made small rather than large. Considering that the body has a well-proved power of adapting the output of nitrogen to the income, within wide limits, it is evident that the quantities of protein katabolized in these experiments can not be taken as an exact measure of the normal permanent demand of these subjects for protein in the daily food; and still less can they be taken as the measure of the average permanent demand for men in general with corresponding muscular activity.

The case with the supply and consumption of energy is somewhat but not wholly similar. The supply was nearly or quite sufficient in the rest experiments, but in the work experiments, especially those with J. C. W., it was so small that the body made considerable drafts upon its reserve store of both nonnitrogenous and nitrogenous compounds. How much of the loss of body protein is to be ascribed to the lack of protein and how much to the lack of total energy in the diet it is impossible to say. Special experiments with different quantities of both protein and energy would be required to settle this ques-

tion. As regards the energy, however, the case is perhaps less obscure. It is safe to say that the body requires a given amount of total energy for sustenance and for the production of a given amount of muscular work and that this demand varies more or less with the amount of muscular activity. It is fair to assume also that when the energy of the food does not meet the needs of the body it will draw upon such reserve materials as it can most conveniently utilize. The general testimony of metabolism experiments is to the effect that the principal draft will be upon the nonnitrogenous materials as long as these last, or until their quantity is so reduced that the body can not well avail itself of more. In these experiments where the energy of the food was deficient the body lost some protein, but more fat, and in so far as can be judged by so limited data facts are in accord with theory.

The question now arises, Can the quantities of energy katabolized in these experiments be taken as the measure of the normal permanent demand for equivalent muscular activity? This involves the question of the extent to which the body can adapt its consumption of energy to the supply in the food, the muscular activity remaining the same. It has such a power of adaptation for protein, though just what are the circumstances under which it can exercise this adaptive power, and to what extent and for how long a time it can do so, the information now available does not determine. It would seem, however, that there must be a more nearly constant ratio between muscular activity and energy katabolism than between such activity and the katabolism of protein. Nor would this hypothesis conflict with the theory advocated by Zuntz,[a] that the normal and permanent demand for protein varies with the intensity of the muscular activity.

If the above reasoning be correct—and this is not wholly certain—the amounts of the energy katabolized in the experiments here reported may be taken as at least approximate indications of the normal and permanent requirements of these particular men for corresponding grades of activity.

In short, it would seem probable that the quantities of protein katabolized in these experiments are rather smaller than, and the quantities of energy are more nearly equivalent to, those that would be permanently required by the same men for normal nutrition under conditions of work and rest similar to those of the experiments; but a great deal more experimenting will be needed for proof that such is the case.

ELIMINATION OF CARBON DIOXID, WATER, AND HEAT.

In the experiments with J. C. W. the elimination of carbon dioxid, water, and heat was determined by two-hour periods, and the statistics

[a] Experiment Station Record, 7 (1895–6), p. 538.

are accordingly quite extensive. Similar statistics for the other subjects are less detailed, as the periods were of six hours each. The statistical details of the experiments with J. C. W. are found in the Appendix to the present report. Those for the other experiments are given in detail in the publications referred to in the chronological list of the experiments on page 101. The present discussion is confined to such tabular summaries and brief explanations of the results obtained as are needed to give an outline of the main results.

Of the experiments with J. C. W., No. 50, of one day's duration, was exceptional, as only one meal was eaten and the work continued only part of the day; No. 55 was also exceptional, for the reason that the work was continued for 16 hours, and also because of errors in the determinations of water and heat eliminated, as explained elsewhere (page 89). Accordingly the figures for these experiments are omitted in making up most of the summary tables and averages, although the values for experiment No. 50 are included in the averages for carbon dioxid and water elimination here discussed.

Of the experiments with the other subjects Nos. 12, 15, 16, 17, and 22, with E. O.; Nos. 18, 19, and 20, with A. W. S., and Nos. 27, 30, and 33, with J. F. S., are also omitted, as they belong with another inquiry.

As explained earlier, the experiments were made under widely different conditions of work and rest and food and fasting. The divisions of the daily observations into short periods makes it possible not only to compare the results for the daytime with those for the night, but also to show the elimination of carbon dioxid, water, and heat for the second half of the night, when the bodily functions are apparently least active. The figures for the latter period are of especial interest as indicating the rates of metabolism of matter and energy when only internal physiological work is being done by the body and that work is at its lowest. In studying the tables in which the results are given in detail and those in which they are summarized it will be interesting to compare the rates of elimination of the night and day periods in the experiments with rest without food (fasting), rest with food, and work with food.

Elimination of carbon dioxid.—The carbon dioxid given off from the body is produced by the oxidation of the carbon of the food and body material, and hence serves as a measure of the amount of that oxidation. The quantity given off in the urine and feces is very small indeed and is here neglected, that given off by the lungs and skin being taken as representing the total elimination. The accuracy with which the carbon dioxid eliminated for a given period measures the production for that period depends upon the amount of time which elapses between the production of the carbon dioxid in the body and its elimi-

nation by the lungs and skin. There seems to be no physiological reason for doubting the possibility of a slight delay in elimination, i. e., a "lag," of carbon dioxid; however, the data of these experiments seem to warrant the deduction that the elimination follows almost immediately upon the production, that is, that the quantities measured in any given period are those actually produced during that period.

The output of carbon dioxid in 2, 6, and 24 hour periods with J. C. W. is shown in detail in Table 119 of the Appendix, and summarized for 2, 6, 12, and 24 hour periods in Table 82 herewith.

TABLE 82.—*Carbon dioxid eliminated during 2-hour periods in 20 metabolism experiments with J. C. W.*

Period.	Rest experiments Nos. 36, 39, 42, and 51 without food.			Rest experiment No. 35 with food.		
	Minimum.	Maximum.	Average.	Minimum.	Maximum.	Average.
	Grams.	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
7 a. m. to 9 a. m	66.5	76.4	72.6	86.3	94.0	90.2
9 a. m. to 11 a. m	49.1	67.8	60.6	70.3	76.4	73.6
11 a. m. to 1 p. m	51.2	61.8	56.4	60.1	69.6	66.6
Total, 6 hours	176.9	202.8	189.6	219.8	238.0	230.4
1 p. m. to 3 p. m	51.4	66.8	59.8	81.9	90.0	85.9
3 p. m. to 5 p. m	50.6	59.2	55.7	66.7	73.8	70.9
5 p. m. to 7 p. m	50.0	63.2	57.1	67.3	85.5	75.2
Total, 6 hours	155.7	186.0	172.6	222.4	242.2	232.0
Total, 12 hours	332.6	388.8	362.2	454.2	472.5	462.4
7 p. m. to 9 p. m	51.9	66.7	61.9	59.4	76.8	67.6
9 p. m. to 11 p. m	48.0	57.6	53.5	67.7	72.8	69.5
11 p. m. to 1 a. m	47.9	54.9	51.8	49.5	66.0	59.5
Total, 6 hours	147.8	178.5	167.2	192.4	203.5	196.6
1 a. m. to 3 a. m	42.4	49.1	46.3	44.4	54.5	50.2
3 a. m. to 5 a. m	44.8	50.8	47.5	49.4	54.0	51.9
5 a. m. to 7 a. m	49.9	56.2	52.9	48.0	53.2	51.0
Total, 6 hours	139.3	151.7	146.7	141.8	161.7	153.1
Total, 12 hours	287.1	330.2	313.9	338.6	359.2	349.7
Total, 24 hours	619.7	711.1	676.1	807.7	821.2	812.1

TABLE 82.—*Carbon dioxid eliminated during 2-hour periods in 20 metabolism experiments with J. C. W.*—Continued.

Period.	Work experiments Nos. 37, 40, 44, 47, 49, and 53 with carbohydrate diet.			Work experiments Nos. 38, 41, 43, 45, 46, 48, 52, and 54 with fat diet.			Extra severe work experiment No. 55 with fat diet.
	Minimum.	Maximum.	Average.	Minimum.	Maximum.	Average.	
	Grams.	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
7 a. m. to 9 a. m	158.2	202.7	177.1	123.5	195.9	163.9	244.5
9 a. m. to 11 a. m	211.0	313.9	276.1	197.8	313.6	259.1	331.4
11 a. m. to 1 p. m	185.1	299.2	240.8	181.2	256.3	219.3	331.1
Total, 6 hours	578.6	775.0	694.0	533.9	715.8	642.3	907.0
1 p. m. to 3 p. m	156.1	232.5	194.1	145.2	224.9	179.2	225.3
3 p. m. to 5 p. m	232.6	315.9	282.8	204.9	319.5	248.9	320.4
5 p. m. to 7 p. m	177.1	283.4	228.7	176.6	251.1	206.7	275.6
Total, 6 hours	580.8	800.1	705.6	535.0	749.9	634.8	821.3
Total, 12 hours	1,181.1	1,521.7	1,399.6	1,075.8	1,382.8	1,277.1	1,728.3
7 p. m. to 9 p. m	85.7	128.0	103.8	67.5	102.7	89.9	242.3
9 p. m. to 11 p. m	82.5	106.7	93.4	69.1	91.1	80.3	322.5
11 p. m. to 1 a. m	53.8	75.3	62.9	52.6	67.2	60.1	277.9
Total, 6 hours	223.9	300.3	260.1	197.9	254.0	230.3	842.7
1 a. m. to 3 a. m	47.4	62.2	52.8	50.4	59.6	54.7	73.1
3 a. m. to 5 a. m	42.7	61.9	52.7	41.9	56.2	50.8	167.2
5 a. m. to 7 a. m	49.8	63.8	55.6	46.0	60.3	52.1	262.3
Total, 6 hours	144.7	182.0	161.1	141.2	173.2	157.6	502 6
Total, 12 hours	368.6	480.5	421.2	348.9	423.7	387.9	1,345.3
Total, 24 hours	1,549.7	1,955.5	1,820.3	1,424.7	1,776.7	1,665.0	3,073.6

The figures of Table 82 are self-explanatory, but reference to some special features will be in place. The differences in output of carbon dioxid are wider in these experiments than in previous ones, which were made with other subjects. This may be explained by the fact that J. C. W. was a larger and heavier man than any of the others; that the differences in diet were wider, and that the amounts of external muscular work were larger in these experiments than in those with the other subjects.

The comparative uniformity in the amounts of carbon dioxid eliminated in the second half of the night, i. e., the 6 hours from 1 a. m. to 7 a. m., is likewise worthy of mention. In experiment No. 55, which continued for only one day, the subject worked 16 hours, as compared with 8 hours in the other work experiments. The fact that part of this work was done at night accounts for the larger elimination during the corresponding night periods. (See Table 119 of Appendix.) He was off the machine from 1 a. m. to 4 a. m., and slept part of this period, and the elimination was reduced, as the figures show. Considering the experiments other than No. 55, the lowest rate of elimination was generally in the two periods from 1 a. m. to 5 a. m., which was

the time of soundest sleep. In these, as in other experiments, it has been noticed that the elimination of carbon dioxid, like that of heat, diminishes as the sleep is more sound, and increases as the subject is more restless in the sleeping hours.

The experiments with J. C. W. and those with the other subjects are summarized together in Table 83. It will be remembered that all the subjects were young, active, healthy men. Aside from the fact that J. C. W. was somewhat larger than the others (see page 98), did more work in the work experiments, and consequently ate more food, there was nothing in their personal characteristics, so far as we have observed, which would lead us to expect any differences in their metabolism of carbon.

TABLE 83.—*Carbon dioxid eliminated by lungs and skin—Average amounts per day and rates and proportions in different periods in metabolism experiments with different subjects.*

Subject and kind of experiment.	Days covered by experiments.	Total amount in 24 hours.	Rate per hour.					Proportion of total for 24 hours.			
			Day periods.		Night periods.		Average for 24 hours.	Day periods.		Night periods.	
			7 a. m. to 1 p. m.	1 p. m. to 7 p. m.	7 p. m. to 1 a. m.	1 a. m. to 7 a. m.		7 a. m. to 1 p. m.	1 p. m. to 7 p. m.	7 p. m. to 1 a. m.	1 a. m. to 7 a. m.
Rest experiments with food.		*Gms.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
E. O., 9 experiments...	33	803	37.9	37.4	36.2	22.3	33.9	28.3	28.0	27.1	16.6
A. W. S., 1 experiment.	3	797	39.8	37.1	32.8	23.2	33.2	29.9	27.9	24.7	17.5
J. F. S., 3 experiments.	9	762	37.0	36.1	31.6	22.3	31.8	29.1	28.4	24.9	17.6
J. C. W., 1 experiment.	4	812	38.4	38.7	32.8	25.5	33.8	28.4	28.6	24.2	18.8
Average of 14 experiments.....	49	796	37.9	37.2	34.9	22.6	33.5	28.6	28.1	26.3	17.0
Rest experiments, fasting.											
J.C.W., 4 experiments.	5	676	31.6	28.8	27.9	24.6	27.3	28.0	25.5	24.7	21.8
Work experiments with food.											
E. O., 2 experiments...	8	1,316	78.4	79.5	38.4	23.1	54.8	35.7	36.3	17.5	10.5
J. F. S., 4 experiments.	12	1,212	73.6	74.7	31.3	22.3	50.5	36.5	37.0	15.5	11.0
J. C.W., 15 experiments	47	1,732	111.2	110.3	40.7	26.5	72.2	38.5	38.2	14.1	9.2
Average of 21 experiments.....	67	1,589	100.5	100.2	38.7	25.3	66.2	38.0	37.9	14.6	9.5

In this table the quantities of carbon dioxid eliminated in the different periods are compared, not only by weights but also by percentages of the amounts for the whole day. The only experiments with fasting were with J. C. W. In these the daily metabolism of carbon was a little smaller than in the corresponding rest experiments with food, but the amounts for the second half of the night are nearly the same with fasting as with food. It will be remembered that the fasting experiments immediately followed those with food.

The average daily amount of external muscular work performed by

each subject has already been shown. (See page 126.) The differences in daily carbon metabolism between the work and rest experiments are very large. As will be seen later (page 134), this difference is equally marked in the elimination of water and the transformation of energy. In fact, these experiments as a whole afford a very clear demonstration of the increase of metabolism with an increase of external muscular work. The average daily amount of carbon dioxid eliminated in the work experiments here tabulated was just about twice as much as in the rest experiments. The extra elimination in the work experiments was confined almost wholly to the day periods when the work was done. During the night periods it was only a little larger in the work experiments than in the rest experiments. In the different tests the amounts were more nearly equal in the second half of the night than in the first half. The average rate of elimination of carbon dioxid by the four subjects between 1 a. m. and 7 a. m. was 22.6 grams per hour in the rest experiments and 25.3 grams per hour in the work experiments, the latter figures being doubtless increased somewhat by the large number of experiments with J. C. W., whose average rate was noticeably greater than that of the other subjects. The smaller of these figures may, perhaps, be taken as an approximate measure of the oxidation of carbon in the body of a healthy, active man when bodily activity is at its lowest.

Elimination of water.—The water taken into the body in the food and drink and formed within it by oxidation of hydrogen is excreted by the intestines, kidneys, lungs, and skin. The amount in the feces is small. That eliminated by the kidneys varies with the amounts taken in the food and drink and eliminated in the respiration and perspiration, and is, in consequence, very irregular. The amount given off by the lungs and skin appears to depend largely upon the muscular activity of the subject and the temperature of the surrounding air, and to be little affected by the income in food and drink.

Total income and outgo of water.—Table 122 of the Appendix compares the daily income of water in food (including milk) and drink with the outgo in feces, urine, respiratory products, and perspiration in the experiments with J. C. W. The maximum, minimum, and average daily rates of income and outgo are summarized in Table 84 herewith, which also compares the averages for this subject and the subjects of earlier experiments. It will be noted that the amount produced by the oxidation of hydrogen, which might be reckoned as part of the income, is not taken into account.

TABLE 84.—*Daily income and outgo of water in metabolism experiments.*

Subject and kind of experiment.	Days covered by experiments.	Income. In food.	Income. In drink.	Income. Total.	Outgo. In feces.	Outgo. In urine.	Outgo. In respiration and perspiration.	Outgo. Total.
Experiments with J. C. W.								
4 rest experiments, fasting:		*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
Maximum per day	5	....	1,950	1,950	....	1,687	1,018	2,529
Minimum per day	5	....	750	750	....	728	768	1,623
Average per day	5	....	1,183	1.183	....	1,198	869	2,067
1 rest experiment with food:								
Maximum per day	4	922	1,000	1,922	78	1,452	954	2,484
Minimum per day	4	922	1,000	1,922	78	1,184	837	2,132
Average per day	4	922	1,000	1,922	78	1,364	881	2,323
14 work experiments with food:								
Maximum per day	46	2,917	2,950	5,092	215	2,648	4,126	5,946
Minimum per day	46	702	1,500	2,602	79	711	2,307	3,231
Average per day	46	1,921	2,329	4,250	156	1,493	3,255	4,904
Rest experiments with food.								
E. O., 9 experiments	33	1,037	1,407	2,444	59	1,808	977	2,844
A. W. S., 1 experiment	3	890	1,385	2,275	46	1,742	859	2,647
J. F. S., 3 experiments	9	1,055	833	1,888	52	1,220	830	2,102
J. C. W., 1 experiment	4	922	1,000	1,922	78	1,364	881	2,323
Average of 14 experiments	49	1,022	1,267	2,289	58	1,660	935	2,653
Work experiments with food.								
E. O., 2 experiments	8	1,168	1,603	2,771	96	1,011	2,275	3,382
J. F. S., 4 experiments	12	975	1,250	2,225	52	905	1,670	2,627
J. C. W., 14 experiments	46	1,921	2,329	4,250	156	1,493	3,255	4,904
Average of 20 experiments	66	1,658	2,045	3,703	130	1,328	2,848	4,306

It is to be remembered that there was considerable milk in the diet of experiments Nos. 5–34 and a large amount of milk and cream in the experiments with fat diet with J. C. W., and that these materials are considered as food rather than drink. How the amounts of water in food and drink in these experiments would compare with those in the average diet of people in general it is impossible to say.

In the rest experiments the average amounts of water in respiration and perspiration were larger with E. O. than with either the other subjects. The number of experimental days with E. O. was twice as large as with all the rest together. The averages in the tables are reckoned, as usual, on the basis of the actual number of days, rather than by averaging the averages of the separate experiments. By this reckoning the general average per day is 935 grams. The general average as computed by averaging the averages for the individual subjects would be 887 grams.

The differences in the intake of water in the rest experiments are wide, and since the output in respiration and perspiration and in the feces is rather uniform, there are naturally wide variations in quantities of the urine, which contains the water not otherwise excreted.

In the work experiments the amounts of food and drink were much larger than in the rest experiments. and the intake of water was correspondingly larger. The water of respiration in the work experiments with E. O. and J. F. S. was from two to two and one-half times as large as in the rest experiments, while with J. C. W., who did more work than either of the others, the outgo was nearly four times as large as in the rest experiments. This increase of water of respiration and perspiration was more than large enough in the work experiments to make up for the increase in the water of food and drink as well as that formed by the oxidation of hydrogen. (See page 137.) Therefore the fact that less water was excreted as urine in the work than in the rest experiments is understandable.

Elimination of water by respiration and perspiration.—Table 120 of the Appendix gives in detail the elimination of water by the lungs and skin in the experiments with J. C. W. for 2, 6, and 24 hour periods and Table 85 herewith summarizes these results.

TABLE 85.—*Water eliminated by lungs and skin during 2-hour periods in 20 metabolism experiments with J. C. W.*

Period.	Rest experiments Nos. 36, 39, 42, and 51, without food.			Rest experiment No. 35, with food.		
	Minimum.	Maximum.	Average.	Minimum.	Maximum.	Average.
	Grams.	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
7 a. m. to 9 a. m	73.3	102.2	87.9	74.3	99.3	85.5
9 a. m. to 11 a. m	61.6	98.9	75.4	68.7	86.9	74.5
11 a. m. to 1 p. m	53.0	96.6	75.4	62.0	81.5	72.2
Total, 6 hours	194.5	291.8	238.7	212.5	267.7	232.2
1 p. m. to 3 p. m	58.6	72.8	66.0	70.7	85.4	75.8
3 p. m. to 5 p. m	55.0	78.4	66.0	68.7	83.9	74.7
5 p. m. to 7 p. m	55.6	79.1	69.0	72.3	86.1	79.3
Total, 6 hours	178.3	229.6	201.0	217.1	255.4	229.8
Total, 12 hours	380.8	508.5	439.7	429.6	523.1	462.0
7 p. m. to 9 p. m	53.2	93.3	70.3	63.9	80.0	71.5
9 p. m. to 11 p. m	61.2	86.2	70.3	70.5	83.7	74.2
11 p. m. to 1 a. m	66.4	81.0	72.0	67.9	73.4	70.8
Total, 6 hours	191.7	260.5	212.6	205.6	234.6	216.5
1 a. m. to 3 a. m	63.2	90.7	73.7	65.9	74.7	69.1
3 a. m. to 5 a. m	60.7	83.0	70.7	50.8	70.6	63.7
5 a. m. to 7 a. m	65.4	79.9	72.4	67.9	71.1	69.7
Total, 6 hours	191.6	253.6	216.8	196.6	211.4	202.5
Total, 12 hours	386.8	514.1	429.4	407.4	431.2	419.0
Total, 24 hours	768.1	1,018.0	869.1	837.0	954.3	881.0

TABLE 85.—*Water eliminated by lungs and skin during 2-hour periods in 20 metabolism experiments with J. C. W.*—Continued.

Period.	Work experiments Nos. 37, 40, 44, 47, 49, and 53, with carbohydrate diet.			Work experiments Nos. 38, 41, 43, 45, 46, 48, 52, and 54, with fat diet.			Extra severe work experiment No. 55, with fat diet.
	Minimum.	Maximum.	Average.	Minimum.	Maximum.	Average.	
	Grams.	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
7 a. m. to 9 a. m	183.9	352.1	260.5	163.7	428.3	281.3	539.0
9 a. m. to 11 a. m	392.0	679.1	527.8	352.1	693.6	544.8	827.3
11 a. m. to 1 p. m	334.0	603.9	481.2	354.9	644.3	493.5	686.4
Total, 6 hours	909.9	1,630.9	1,269.5	872.2	1,672.6	1,319.6	2,052.7
1 p. m. to 3 p. m	190.2	400.2	328.6	228.7	435.8	338.7	579.5
3 p. m. to 5 p. m	394.8	680.3	553.9	391.3	703.7	558.3	839.0
5 p. m. to 7 p. m	303.0	590.2	464.7	332.9	625.5	444.2	656.9
Total, 6 hours	915.0	1,659.5	1,347.2	995.0	1,708.1	1,341.2	2,075.4
Total, 12 hours	1,851.3	3,290.4	2,616.7	1,867.2	3,370.2	2,660.8	4,128.1
7 p. m. to 9 p. m	96.1	175.7	128.8	107.1	172.9	136.4	596.3
9 p. m. to 11 p. m	92.1	153.2	123.1	90.2	174.8	123.6	814.3
11 p. m. to 1 a. m	68.2	122.7	93.5	59.6	128.3	96.5	471.1
Total, 6 hours	270.2	418.4	345.4	262.5	465.0	356.5	1,881.7
1 a. m. to 3 a. m	62.3	116.5	88.5	66.0	128.2	95.7	457.2
3 a. m. to 5 a. m	60.1	116.7	85.4	57.2	126.9	89.4	465.8
5 a. m. to 7 a. m	61.6	106.6	81.4	53.7	111.5	86.7	448.2
Total, 6 hours	189.2	339.8	255.3	176.9	362.0	271.8	1,371.2
Total, 12 hours	459.4	749.4	600.7	439.4	827.0	628.3	3,252.9
Total, 24 hours	2,310.7	4,024.0	3,217.4	2,306.6	4,126.5	3,289.1	7,381.0

From this table it will be seen that in the rest experiments with J. C. W. the amount of water eliminated by the lungs and skin was nearly the same when the food was abundant as in fasting; that it was greater with work than with rest; that it increased with an increase in muscular work, the amount with hard work for 16 hours a day being more than twofold that for 8 hours' work, and slightly greater in the case of work with a fat diet than with a carbohydrate diet. These data, however, are only for one subject, and the number of experiments is too small to establish a ratio between muscular work and the elimination of water from the lungs and skin.

The average daily amounts of water eliminated by the lungs and skin and the proportions for the different periods of the day in experiments with J. C. W., as compared with those for experiments with other subjects, are shown in Table 86.

TABLE 86.—*Water eliminated by lungs and skin—Average amounts per day and rates and proportions for different periods.*

Subject and kind of experiments.	Duration.	Total amounts in 24 hours.	Rates per hour. Day periods. 7 a. m. to 1 p. m.	1 p. m. to 7 p. m.	Night periods. 7 p. m. to 1 a. m.	1 a. m. to 7 a. m.	Average for 24 hours.	Proportion of total for 24 hours. Day periods. 7 a. m. to 1 p. m.	1 p. m. to 7 p. m.	Night periods. 7 p. m. to 1 a. m.	1 a. m. to 7 a. m.
Rest experiments with food.	*Days.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
E. O., 9 experiments ...	33	977	39.1	41.8	43.7	38.2	40.7	24.0	25.7	26.8	23.5
A. W. S., 1 experiment.	3	859	36.3	36.2	37.4	33.3	35.8	25.3	25.3	26.1	23.3
J. F. S., 3 experiments.	9	830	36.0	36.0	35.2	31.1	34.6	26.0	26.0	25.5	22.5
J. C. W., 1 experiment..	4	881	38.7	38.3	36.1	33.7	36.7	26.3	26.1	24.6	23.0
Average of above rest experiments	49	935	38.3	40.1	41.1	36.2	38.9	24.6	25.8	26.3	23.3
Work experiments with food.											
E. O., 2 experiments ...	8	2,275	120.3	108.5	85.6	64.8	94.8	31.7	28.6	22.6	17.1
J. F. S., 4 experiments..	12	1,670	98.5	111.5	34.8	33.5	69.6	35.4	40.1	12.5	12.0
J.C.W., 15 experiments.	47	3,233	215.4	221.3	58.3	43.8	134.7	40.1	41.0	10.8	8.1
Average of above work experiments	67	2,839	183.1	188.2	57.4	44.5	118.3	38.7	39.8	12.1	9.4

It is commonly assumed that the expired air is saturated with moisture. Supposing this to be a fact, the quantity of water given off from the lungs would be proportional to the amount of expired air. In times of active muscular exercise the volumes of water given off from the lungs would increase. Furthermore, the perspiration increases greatly with the muscular activity. As noted above with J. F. S. the amount of water excreted per day from the lungs and skin in the work experiments was about twice, with E. O. nearly 2.5 times, and with J. C. W. nearly four times as large as in the rest experiments.

The balance of income and outgo of water is decided not only by the amounts in food and drink and the quantities excreted by the kidneys, lungs, and skin, but also by two other factors. One of these is the amount of water formed within the body by the oxidation of hydrogen; the other is the change in the amount of water in the alimentary canal and in the tissues and fluids of the body. This topic can not be satisfactorily discussed until additional data, which are being accumulated, are available. One point, however, is so interesting that a word regarding it may be in place here. Comparisons of figures for the amounts of hydrogen oxidized, as given in the tabular details of the experiments, show that if all the water formed by the oxidation of the hydrogen of the food and body material were eliminated through the lungs and skin and none through the kidneys, it would account for only about one-third of the water of respiration in the rest experiments and only about one-fourth of that in the work

experiments. It is therefore evident that the increase of water of respiration and perspiration during periods of muscular activity is due not so much to an increased oxidation of hydrogen as to an increased excretion through the lungs and skin of water derived from some other source.

In the rest experiments the amounts eliminated between 7 a. m. and 7 p. m. and between 7 p. m. and 7 a. m. (the day and night periods, respectively) are nearly the same, the proportions being respectively 50.4 and 49.6 per cent of the total for the 24 hours. Although there was considerable variation in the elimination of water in the urine with the different subjects, the range in the amounts eliminated by the lungs and skin during the different periods is not wide. The quantity in the second night period is the smallest of all, as would be expected with the diminished bodily activity.

In the work experiments the variations are much larger between different subjects and between different periods for the same subject. As already pointed out, with J. F. S. the average elimination by lungs and skin for 24 hours was twice as much in the work as in the rest experiments, and with E. O. it was 2.5 as much, while with J. C. W. it was four times as much. The larger increase with the latter subject coincides with his larger amount of work.

Comparing the day and night periods in the work experiments, it is interesting to note that with E. O. the amount by day was only 60.3 per cent of the whole for the 24 hours, while with J. F. S. it was 75 per cent, and with J. C. W. 81.1 per cent. Whether this disparity is wholly due to differences in the amounts of muscular work or part is to be accounted for by differences in the "lag" in the elimination of water, i. e., differences in the lapse of time between the ingestion of water in food and drink or its formation by the oxidation of hydrogen on the one hand and its elimination by various channels on the other, it is impossible to say.

Elimination of energy.—In the present discussion of this topic it is assumed that the body gives off energy in only two forms—heat and external muscular work.

Measurements of energy.—In the measurements of energy of income and outgo of the body the temperature of the respiration chamber, generally about 20°, is taken as the basis for computations of the heat removed or given off by food, drink, and excretory products in the chamber. The kinetic energy given off by the body is measured in these experiments as the sum of three quantities: (1) The heat taken up by the water current in its passage through the absorber system in the respiration chamber; (2) the latent heat of the water vapor given off by the body, i. e., of the water vaporized by the heat of the body and carried out in the air current, due corrections being made for water condensed upon the absorbers; and (3) the heat equivalent of the external muscular work done.

The heat carried away by the water current includes (*a*) the heat given off from the skin by radiation and conduction; (*b*) that brought out of the body in the feces and urine and given off in the cooling of these excretory products to the temperature of the chamber; (*c*) that brought out of the body in the air, carbon dioxid, and water excreted by the lungs and skin and given off in their cooling to the respiration chamber temperature; (*d*) the latent heat of vaporization of so much of the water of (*c*) as is permanently condensed on the absorbers (mainly collected as drip water); and (*e*) the heat produced by the transformation of the external muscular work. The heat of (*a*), (*b*), (*c*), and (*e*) finds its way by radiation and conduction to the surface of the copper absorbers and passes with that of (*d*) into the water current by which it is carried out of the chamber.

The latent heat of the water vaporized by the body leaves the respiration chamber in the air current, and although the air current enters and leaves the chamber at the same temperature, it carries out more heat than it brings in, the extra heat being the latent heat of the water vapor added to the air of the chamber by the subject.[a] The amount of this heat is learned from the amount of water vapor and its latent heat of vaporization at the given temperature.

The heat equivalent of the external muscular work performed by the subject is calculated from the measurements made by the bicycle ergometer, although the energy thus generated is actually transformed into heat, which is carried away by the water current and measured with the rest of the heat given off by the body.

We have then to consider: (1) the total energy eliminated in the two forms of heat and external muscular work, and (2), the separate amounts of energy given off in different ways—(*a*), (*b*), (*c*), (*d*), and (*e*), noted above.

Total energy eliminated.—The average amounts of energy given off by the body in the 2, 6, and 24 hour periods into which the experimental days of the tests with J. C. W. were divided are shown in detail in Table 124 of the Appendix and summarized in Table 87.

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[a] The differences in specific heat of the air due to loss of oxygen and gain of carbon dioxid are here assumed to be negligible.

TABLE 87.—*Total heat eliminated during 2-hour periods in 20 metabolism experiments with J. C. W.*

Period.	Rest experiments Nos. 36, 39, 42, and 51, without food.			Rest experiment No. 35, with food.			Work experiments Nos. 37, 40, 44, 47, 49, and 53, with carbohydrate diet.			Work experiments Nos. 38, 41, 43, 45, 46, 48, 52, and 54, with fat diet.			Extra severe work—Experiment No. 55.
	Minimum.	Maximum.	Average.	Minimum.	Maximum.	Average.	Minimum.	Maximum.	Average.	Minimum.	Maximum.	Average.	
	Cals.	*Cals.*	*Cals.*	*Cals.*	*Cals.*	*Cals.*	*Cals.*	*Cals.*	*Cals.*	*Cals.*	*Cals.*	*Cals.*	*Cals.*
7 a. m. to 9 a. m	219	273	244	246	267	254	431	567	486	409	574	487	696
9 a. m. to 11 a. m	148	235	194	225	248	233	630	876	778	635	889	776	983
11 a. m. to 1 p. m	148	206	182	198	218	210	543	759	683	564	840	683	965
Total, 6 hours.	522	714	620	674	733	697	1,637	2,120	1,947	1,624	2,229	1,946	2,644
1 p. m. to 3 p. m	163	216	195	226	236	231	443	620	532	432	664	535	700
3 p. m. to 5 p. m	158	199	181	220	229	225	661	877	791	662	924	776	1,006
5 p. m. to 7 p. m	166	213	187	210	228	217	536	763	641	482	772	601	779
Total, 6 hours.	487	611	563	665	680	673	1,686	2,190	1,964	1,610	2,277	1,912	2,485
Total, 12 hours	1,009	1,314	1,183	1,350	1,413	1,370	3,380	4,205	3,911	3,234	4,221	3,858	5,129
7 p. m. to 9 p. m	143	241	192	205	234	220	258	338	292	259	327	291	762
9 p. m. to 11 p. m	160	234	194	200	228	213	221	328	278	240	304	270	958
11 p. m. to 1 a. m	132	176	154	132	156	145	135	195	170	141	209	177	878
Total, 6 hours.	467	651	540	538	614	578	647	859	740	654	825	738	2,598
1 a. m. to 3 a. m	131	161	148	142	172	155	148	191	167	154	196	179	190
3 a. m. to 5 a. m	128	169	148	123	155	140	123	187	157	141	187	165	532
5 a. m. to 7 a. m	157	177	168	138	164	154	143	182	162	141	200	164	865
Total, 6 hours.	457	485	464	406	479	449	427	553	486	463	542	508	1,587
Total, 12 hours	928	1,136	1,004	1,001	1,063	1,027	1,075	1,400	1,226	1,118	1,348	1,246	4,185
Total, 24 hours	1,946	2,362	2,187	2,375	2,414	2,397	4,458	5,495	5,137	4,352	5,527	5,104	9,314

In this table it will be seen that the elimination of heat during the second period of the night is very nearly the same in all the experiments, whether they were rest experiments with fasting, rest experiments with food, or work experiments, and that in the work experiments the average amounts are practically the same with the different diets.

These results are compared with those of the experiments with the other subjects in Table 88, in which, however, the distinction is made, in the work experiments, between the energy eliminated as heat and the energy measured as external muscular work. The energy eliminated as heat includes the heat given off from the body by radiation and conduction, and that given off in the water vaporized from the body during the same periods and carried out of the respiration chamber in the outgoing air current.

TABLE 88.—*Heat given off by body, including for work experiments the heat equivalent of the external muscular work—Amounts per day and rates and proportions for different periods.*

Subject and kind of experiment.	Duration.	Total amount in 24 hours.	Rates per hour. Day periods. 7 a.m. to 1 p.m.	Rates per hour. Day periods. 1 p.m. to 7 p.m.	Rates per hour. Night periods. 7 p.m. to 1 a.m.	Rates per hour. Night periods. 1 a.m. to 7 a.m.	Rates per hour. Average for 24 hours.	Proportion of total for 24 hours. Day periods. 7 a.m. to 1 p.m.	Proportion of total for 24 hours. Day periods. 1 p.m. to 7 p.m.	Proportion of total for 24 hours. Night periods. 7 p.m. to 1 a.m.	Proportion of total for 24 hours. Night periods. 1 a.m. to 7 a.m.
Rest experiments.	*Days.*	*Cals.*	*Cals.*	*Cals.*	*Cals.*	*Cals.*	*Cals.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
E. O., 9 experiments	33	2,278	103.7	105.0	101.8	69.2	95.0	27.3	27.7	26.8	18.2
A. W. S., 1 experiment	3	2,279	114.5	104.5	93.3	67.5	95.0	30.1	27.5	24.6	17.8
J. F. S., 3 experiments	9	2,136	109.0	98.7	88.2	60.2	89.0	30.6	27.7	24.8	16.9
J. C. W., 1 experiment	4	2,397	116.1	112.2	96.3	74.9	99.9	29.1	28.1	24.1	18.7
Average for above rest experiments	49	2,262	106.3	104.4	98.3	67.9	94.3	28.2	27.7	26.1	18.0
Work experiments.											
E. O., 2 experiments:											
Heat eliminated	......	3,601	185.2	203.2	120.5	74.0	145.7	......	......	......	......
Heat equivalent of external muscular work	......	228	27.0	28.3	......	......	......	......	......	......	......
Total	8	3,829	212.2	231.5	120.5	74.0	159.6	33.2	36.3	18.9	11.6
J. F. S., 4 experiments:											
Heat eliminated	......	3,302	181.6	187.1	97.2	64.2	132.5	......	......	......	......
Heat equivalent of external muscular work	......	238	30.4	29.6	......	......	......	......	......	......	......
Total	12	3,540	212.0	216.7	97.2	64.2	147.5	35.9	36.7	16.5	10.9
J. C. W., 14 experiments:											
Heat eliminated	......	4,574	256.6	253.9	123.2	82.9	179.2	......	......	......	......
Heat equivalent of external muscular work	......	546	67.8	68.9	......	......	......	......	......	......	......
Total	46	5,120	324.4	322.8	123.2	82.9	213.3	38.0	37.8	14.5	9.7
Average for above work experiments:											
Heat eliminated	......	4,225	231.7	235.6	118.1	78.4	166.6	......	......	......	......
Heat equivalent of external muscular work	......	451	58.5	56.8	......	......	......	......	......	......	......
Total	......	4,676	290.2	292.4	118.1	78.4	194.8	37.2	37.5	15.2	10.1

The temperature of the body[a], the amount of reserve or stored material it contains, and the intestinal content vary somewhat from time to time. It is assumed that at the hour when the experimental day begins and ends, 7 a. m., they will be very nearly the same from day to day. If they are the same at these times the total quantity of heat in the body at the beginning and end of each experimental day will be the same. The total quantity of energy given off from the body during the day will in this case be equivalent to the total amount liberated within the body and will be closely parallel with the amounts of

[a] See discussion of body temperature on pages 149–154.

carbon and hydrogen oxidized. Taking each of these four periods of the day by itself, the differences between the amounts of heat stored in the body at the beginning and end will probably be larger than is the case for the whole day. For individual periods, therefore, the parallelism between the amounts of carbon oxidized and heat given off will hardly be as close as for the whole day.

In the 14 rest experiments summarized in Table 88, covering all told 49 days, the hourly rates of heat elimination for each period are nearly alike for all the subjects. It follows that the same is true for the percentages. As will be seen in a later discussion, the total amounts vary almost exactly with the weight and body surface of the subject.

In the 20 work experiments, covering 66 days altogether, the rates of elimination vary greatly with the different subjects, except during the second night period, when the total amounts are but little larger than for the corresponding period in the rest experiments. The larger amounts of heat eliminated during this period in work experiments can doubtless be explained by the fact that the subjects as a rule are more restless during the night following a day of work than during the night after a day of rest.

It will also be noticed that the heat equivalent of the external muscular work with J. C. W. was more than twice as great as with either of the other subjects. The energy of the food consumed by this subject was also much greater than that furnished by the rations used in the other experiments. This will explain, to some extent at least, the increased elimination of heat by radiation, conduction, and vaporization of water by J. C. W.

Amounts of energy eliminated in different ways.—Table 123 of the Appendix shows in detail the amounts of energy given off from the body in different ways in experiments with J. C. W., these data being summarized in Table 89, which for comparison gives also the averages of the results of experiments with the other subjects.

TABLE 89.—*Energy given off by the body in different ways—Amounts per day and proportions of total eliminated in various ways.*

Subject and kind of experiment.	Days covered by experiments.	Quantities of energy per day.					Energy expressed in proportions of total.			
		Heat eliminated.					Heat eliminated.			
		By radiation and conduction.	In urine and feces.	In water vaporized from lungs and skin.	Heat equivalent of external muscular work.	Total.	By radiation and conduction.	In urine and feces.	In water vaporized from lungs and skin.	Heat equivalent of external muscular work.
Experiments with J. C. W.										
Rest, with food, 1 experiment:		*Cals.*	*Cals.*	*Cals.*	*Cals.*	*Cals.*	*Pr. ct.*	*Pr. ct.*	*Pr. ct.*	*Pr. ct.*
Maximum	......	1,875	27	565	......	2,414	......	......	......	......
Minimum	......	1,822	23	495	......	2,375	......	......	......	......
Average	4	1,850	26	521	......	2,397	77.2	1.1	21.7	......
Rest, fasting, 4 experiments:										
Maximum	......	1,774	30	611	......	2,362	......	......	......	......
Minimum	......	1,342	13	455	......	1,946	......	......	......	......
Average	5	1,605	21	561	......	2,187	73.4	1.0	25.6	......
Work, 14 experiments:										
Maximum	......	4,151	49	882	649	5,527	......	......	......	......
Minimum	......	3,099	15	665	481	4,352	......	......	......	......
Average	46	3,802	29	743	546	5,120	74.2	.6	14.5	10.7
Rest experiments, with food.										
E. O., average 9 experiments	33	1,675	33	570	......	2,278	73.5	1.5	25.0	......
A. W. S., average 1 experiment	3	1,739	31	509	......	2,279	76.3	1.4	22.3	......
J. F. S., average 3 experiments	9	1,622	23	491	......	2,136	75.9	1.1	23.0	......
J. C. W., average 1 experiment	4	1,850	26	521	......	2,397	77.2	1.1	21.7	......
Average 14 experiments	49	1,683	31	548	......	2,262	74.4	1.4	24.2	......
Work experiments.										
E. O., average 2 experiments	8	2,249	20	1,332	228	3,829	58.7	.5	34.8	6.0
J. F. S., average 4 experiments	12	2,296	18	988	238	3,540	64.9	.5	27.9	6.7
J. C. W., average 14 experiments	46	3,802	29	743	546	5,120	74.2	.6	14.5	10.7
Average 20 experiments	66	3,340	26	859	451	4,676	71.4	.6	18.4	9.6

The figures for "radiation and conduction" in the second column are obtained by subtracting the sum of the quantities of heat given off by the feces and urine in cooling and by the water in condensing on the absorbers and the heat equivalent of the external work (page 338) from the total heat taken from the chamber by the water current; that is, they are obtained by subtracting the sum of the quantities in the third, fourth, and fifth columns from the total in the sixth column. Accordingly they represent the sum of quantities of heat given off by the lungs and skin directly as heat and by the water and carbon dioxid of respiration and perspiration in cooling to the temperature of the respiration chamber.

The figures for the heat given off from the urine and feces, as shown in the third column in Table 89, are calculated from the weights of these excreta, their fall in temperature from that of the body to that of the respiration chamber, a fall averaging 17°, and their specific heats, which are arbitrarily assumed to be for feces 0.9 and for urine 1.0.

The figures in the fourth column represent the latent heat of vaporization of the water given off by the lungs and skin. For the rest experiments this water is in general that carried out of the chamber in the air current in excess of that brought into the chamber by the same current. Occasionally in rest experiments, however, and in all the work experiments more or less water is condensed on the absorbers and is not carried out by the air current. The figures in the third column include the heat given off in the condensation of this water vapor upon the absorbers, along with the latent heat of vaporization of the water in the air current. The reason why generally little or no water was condensed on the surfaces of the absorbers in the rest experiments is that the temperature of the incoming water current was as a rule above the dew-point of the air inside the chamber.

The fifth column shows the heat equivalent of the external muscular work, as measured by the bicycle dynamo apparatus, by which the mechanical work is transformed into electrical energy and into heat.

As would be expected, the smallest elimination by radiation and conduction was found in the fasting experiments and the largest in the work experiments. The elimination in urine and feces was very nearly the same in all the experiments, being lowest in the fasting experiments, where all heat eliminated in this way was from the urine, as no feces were passed. The heat eliminated in water vaporized from the lungs and skin was larger in fasting experiments than in rest experiments with food, and about 30 per cent higher in the work experiments than in the fasting experiments.

In comparing the total amounts it will be noticed that in the rest experiments the amount eliminated when fasting was but 10 per cent less than with food. The larger amount in the rest experiments with food than in fasting may be due, in part at least, to the energy expended in digestion.

As regards the experiments as a whole, it will be seen that in 14 rest experiments with food (covering 49 days), with four subjects, the average total daily elimination of heat was nearly the same for all the subjects, and the percentages eliminated in various ways were nearly the same, about 75 per cent being given off by radiation and conduction, 24 per cent in water vaporized from lungs, and a trifle over 1 per cent in the urine and feces. In the work experiments there is a much larger range of variation.

Comparison of percentages of carbon dioxid, water, and heat eliminated in different periods of the day.—Table 90 summarizes the proportions of the total daily amounts of carbon dioxid, water, and heat eliminated in 2, 6, 12, and 24 hour periods, in experiments with J. C. W., omitting experiment No. 50, which, as previously explained, was exceptional. After what has been said of the results expressed in the preceding tables comment upon this one is hardly necessary.

TABLE 90.—*Proportion of carbon dioxid, water, and heat eliminated during different periods of the day—Average of 20 experiments with J. C. W.*

Period.	Rest experiments Nos. 36, 39, 42, and 51, without food.			Rest experiment No. 35, with food.		
	Carbon dioxid.	Water.	Heat.	Carbon dioxid.	Water.	Heat.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
7 a. m. to 9 a. m	10.74	10.10	11.16	11.11	9.70	10.59
9 a. m. to 11 a. m	8.96	8.68	8.87	9.06	8.46	9.72
11 a. m. to 1 p. m	8.34	8.68	8.32	8.20	8.20	8.76
Total, 6 hours	28.04	27.46	28.35	28.37	26.36	29.07
1 p. m. to 3 p. m	8.84	7.59	8.91	10.58	8.60	9.64
3 p. m. to 5 p. m	8.24	7.60	8.28	8.73	8.48	9.39
5 p. m. to 7 p. m	8.45	7.94	8.55	9.26	9.00	9.05
Total, 6 hours	25.53	23.13	25.74	28.57	26.08	28.08
Total, 12 hours	53.57	50.59	54.09	56.94	52.44	57.15
7 p. m. to 9 p. m	9.16	8.09	8.78	8.32	8.12	9.18
9 p. m. to 11 p. m	7.91	8.09	8.87	8.56	8.42	8.89
11 p. m. to 1 a. m	7.66	8.28	7.04	7.33	8.04	6.05
Total, 6 hours	24.73	24.46	24.69	24.21	24.58	24.12
1 a. m. to 3 a. m	6.85	8.48	6.77	6.18	7.84	6.47
3 a. m. to 5 a. m	7.03	8.14	6.77	6.39	7.23	5.84
5 a. m. to 7 a. m	7.82	8.33	7.68	6.28	7.91	6.42
Total, 6 hours	21.70	24.95	21.22	18.85	22.98	18.73
Total, 12 hours	46.43	49.41	45.91	43.06	47.56	42.85
Total, 24 hours	100.00	100.00	100.00	100.00	100.00	100.00

Period.	Work experiments Nos. 37, 40, 44, 47, 49, and 53, with carbohydrate diet.			Work experiments Nos. 38, 41, 43, 45, 46, 48, 52, and 54, with fat diet.		
	Carbon dioxid.	Water.	Heat.	Carbon dioxid.	Water.	Heat.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
7 a. m. to 9 a. m	9.73	8.10	9.46	9.84	8.55	9.54
9 a. m. to 11 a. m	15.16	16.40	15.15	15.56	16.56	15.21
11 a. m. to 1 p. m	13.22	14.96	13.29	13.17	15.01	13.38
Total, 6 hours	38.11	39.46	37.90	38.57	40.12	38.13
1 p. m. to 3 p. m	10.66	10.21	10.35	10.76	10.30	10.48
3 p. m. to 5 p. m	15.53	17.22	15.40	14.95	16.98	15.21
5 p. m. to 7 p. m	12.56	14.44	12.48	12.42	13.50	11.77
Total, 6 hours	38.75	41.87	38.23	38.13	40.78	37.46
Total, 12 hours	76.86	81.33	76.13	76.70	80.90	75.59
7 p. m. to 9 p. m	5.70	4.00	5.69	5.40	4.15	5.70
9 p. m. to 11 p. m	5.13	3.83	5.41	4.82	3.76	5.29
11 p. m. to 1 a. m	3.46	2.91	3.31	3.61	2.93	3.47
Total, 6 hours	14.29	10.74	14.41	13.83	10.84	14.46
1 a. m. to 3 a. m	2.90	2.75	3.25	3.29	2.91	3.51
3 a. m. to 5 a. m	2.90	2.65	3.06	3.05	2.72	3.23
5 a. m. to 7 a. m	3.05	2.53	3.15	3.13	2.63	3.21
Total, 6 hours	8.85	7.93	9.46	9.47	8.26	9.95
Total, 12 hours	23.14	18.67	23.87	23.30	19.10	24.41
Total, 24 hours	100.00	100.00	100.00	100.00	100.00	100.00

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Elimination of carbon dioxid, water, and energy per kilogram of body weight and per square meter of body surface.—Table 68, on page 98, gives the statistics of the weights of the different subjects in kilograms and the estimates of the body surface of each in square meters. The subjects were weighed without clothing or in light underclothing. Tables 83 and 86, pages 132 and 137, show the average amounts of carbon dioxid and water from lungs and skin eliminated per hour for 6 and 24 hour periods. From these the average hourly eliminations of carbon dioxid and water per kilogram of body weight and per square meter of body surface of the different subjects may be readily calculated, as is done in Table 91. In like manner the rates of elimination of energy have been computed from the data in Table 88 and the results shown in Table 92.

TABLE 91.—*Hourly rates of elimination of carbon dioxid and water per kilogram of body weight and per square meter of body surface of different subjects—Rates in different parts of the day and averages for whole day.*

Subject and kind of experiment.	Duration.	Amounts eliminated per hour per kilogram of body weight.				
		Day periods.		Night periods.		Average for 24 hours.
		7 a. m. to 1 p. m.	1 p. m. to 7 p. m.	7 p. m. to 1 a. m.	1 a. m. to 7 a. m.	
Carbon dioxid.						
Rest experiments with food:	*Days.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
E. O., 9 experiments	33	0.54	0.53	0.52	0.32	0.48
A. W. S., 1 experiment	3	.57	.53	.47	.33	.47
J. F. S., 3 experiments	9	.57	.56	.49	.34	.49
J. C. W., 1 experiment	4	.51	.51	.43	.34	.44
Average for above rest experiments	49	.54	.54	.50	.33	.48
Rest experiments, fasting:						
J. C. W., 4 experiments	5	.42	.38	.37	.32	.37
Work experiments with food:						
E. O., 2 experiments	8	1.12	1.14	.55	.33	.78
J. F. S., 4 experiments	12	1.13	1.15	.48	.34	.78
J. C. W., 15 experiments	47	1.46	1.45	.54	.35	.95
Average for above work experiments	67	1.37	1.37	.53	.35	.90
Water.						
Rest experiments with food:						
E. O., 9 experiments	33	.56	.60	.62	.55	.58
A. W. S., 1 experiment	3	.52	.52	.53	.48	.51
J. F. S., 3 experiments	9	.55	.55	.54	.48	.53
J. C. W., 1 experiment	4	.51	.50	.48	.44	.48
Average for above rest experiments	49	.55	.58	.59	.52	.56
Rest experiments, fasting:						
J. C. W., 4 experiments	5	.52	.44	.47	.48	.48
Work experiments with food:						
E. O., 2 experiments	8	1.72	1.55	1.22	.93	1.35
J. F. S., 4 experiments	12	1.52	1.72	.54	.52	1.07
J. C. W., 15 experiments	47	2 83	2.91	.77	.58	1.77
Average for above work experiments	67	2.50	2.57	.78	.61	1.61

TABLE 91.—*Hourly rates of elimination of carbon dioxid and water per kilogram of body weight and per square meter of body surface of different subjects, etc.*—Continued.

Subject and kind of experiment.	Duration.	Amounts eliminated per hour per square meter of body surface.				
		Day periods.		Night periods.		Average for 24 hours.
		7 a. m. to 1 p. m.	1 p. m. to 7 p. m.	7 p. m. to 1 a. m.	1 a. m. to 7 a. m.	
Carbon dioxid.						
Rest experiments with food:	*Days.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
E. O., 9 experiments	33	18.13	17.89	17.32	10.67	16.22
A. W. S., 1 experiment	3	19.04	17.75	15.69	11.10	15.89
J. F. S., 3 experiments	9	18.59	18.14	15.88	11.21	15.98
J. C. W., 1 experiment	4	17.38	17.51	14.84	11.54	15.29
Average for above rest experiments.	49	18.22	17.89	16.78	10.87	16.11
Rest experiments, fasting:						
J. C. W., 4 experiments	5	14.30	13.03	12.62	11.04	12.76
Work experiments with food:						
E. O., 2 experiments	8	37.51	38.04	18.37	11.05	26.22
J. F. S., 4 experiments	12	36.98	37.54	15.73	11.21	25.38
J. C. W., 15 experiments	47	50.32	49.91	18.42	11.99	32.67
Average for above work experiments	67	46.61	46.47	17.95	11.73	30.71
Water.						
Rest experiments with food:						
E. O., 9 experiments	33	18.71	20.00	20.91	18.28	19.47
A. W. S., 1 experiment	3	17.37	17.32	17.89	15.93	17.13
J. F. S., 3 experiments	9	18.09	18.09	17.69	15.63	17.39
J. C. W., 1 experiment	4	17.51	17.33	16.33	15.25	16.61
Average for above rest experiments.	49	18.41	19.28	19.76	17.40	18.70
Rest experiments, fasting:						
J. C. W., 4 experiments	5	18.01	15.16	16.02	16.33	16.38
Work experiments with food:						
E. O., 2 experiments	8	57.56	51.91	40.96	31.00	45.36
J. F. S., 4 experiments	12	49.50	56.03	17.49	16.83	34.97
J. C. W., 15 experiments	47	97.47	100.14	26.38	19.82	60.95
Average for above work experiments	67	84.92	87.29	26.62	20.64	54.87

TABLE 92.—*Hourly rates of elimination of heat per kilogram of body weight and per square meter of body surface of different subjects—Rates in different parts of day and averages for whole day.*

Subject and kind of experiment.	Duration.	Heat eliminated per hour. Per kilogram of body weight.					Per square meter of body surface.				
		7 a. m. to 1 p. m.	1 p. m. to 7 p. m.	7 p. m. to 1 a. m.	1 a. m. to 7 a. m.	Average for 24 hours.	7 a. m. to 1 p. m.	1 p. m. to 7 p. m.	7 p. m. to 1 a. m.	1 a. m. to 7 a. m.	Average for 24 hours.
Rest experiments with food.	*Days.*	*Cals.*	*Cals.*	*Cals.*	*Cals.*	*Cals.*	*Cals.*	*Cals.*	*Cals.*	*Cals.*	*Cals.*
E. O., 9 experiments	33	1.48	1.50	1.45	0.99	1.36	49.6	50.2	48.7	33.1	45.5
A. W. S., 1 experiment	3	1.64	1.49	1.33	.96	1.36	54.8	50.0	41.6	32.3	45.5
J. F. S., 3 experiments	9	1.68	1.52	1.36	.93	1.37	54.8	49.6	44.3	30.3	44.7
J. C. W., 1 experiment	4	1.53	1.48	1.27	.99	1.31	52.5	50.8	43.6	33.9	45.2
Average for above rest experiments	49	1.53	1.50	1.41	.98	1.35	51.1	50.2	47.3	32.6	45.3
Rest experiments, fasting:											
J. C. W., 4 experiments	5	1.36	1.23	1.19	1.02	1.20	46.8	42.4	40.8	35.0	41.2
Work experiments.											
E. O., 2 experiments:											
Heat eliminated	......	2.65	2.90	1.72	1.06	2.08	88.6	97.2	57.7	35.4	69.7
Heat equivalent of external muscular work	......	.38	.41	......	......	......	12.9	13.7	......	......	......
Total	8	3.03	3.31	1.72	1.06	2.28	101.5	110.8	57.7	35.4	76.4
J. F. S., 4 experiments:											
Heat eliminated	......	2.79	2.88	1.50	.99	2.04	91.3	94.0	48.8	32.3	66.6
Heat equivalent of external muscular work	......	.47	.45	......	......	......	14.7	14.9	......	......	......
Total	12	3.26	3.33	1.50	.99	2.27	106.0	108.9	48.8	32.3	74.1
J.C.W., 14 experiments:											
Heat eliminated	......	3.38	3.34	1.62	1.09	2.36	116.1	114.9	55.7	37.5	81.1
Heat equivalent of external muscular work	......	.89	.91	......	......	......	30.7	31.1	......	......	......
Total	46	4.27	4.25	1.62	1.09	2.81	146.8	146.1	55.7	37.5	96.5
Average for above work experiments:											
Heat eliminated	......	3.08	3.09	1.61	1.07	2.21	104.8	105.2	54.8	36.4	75.3
Heat equivalent of external muscular work	......	.88	.90	......	......	......	29.9	30.4	......	......	......
Total	66	3.96	3.99	1.61	1.07	2.66	134.7	135.6	54.8	36.4	90.4

In the rest experiments it is noticeable that the hourly rates of elimination of carbon dioxid, water, and heat during the different periods of the day and for the whole day were very uniform for all the subjects, both per kilogram of body weight and per square meter of body surface.

In the work experiments the differences in elimination by the different subjects in the day periods were wide, as would be expected in view

of the differences in the amount of muscular work. On the other hand the rates were nearly alike during both night periods for the carbon dioxid and heat, though the variations in water elimination were considerable.

Comparing the averages of work and rest experiments it will be seen that the amounts of carbon dioxid, water, and heat eliminated per hour per kilogram of body weight and per square meter of surface area were very nearly the same during the last night period. This is to be expected, as the body functions during that period are at the lowest point of activity. The rates were also very uniform for the first night period in the case of carbon dioxid and heat, but for water there was a slight variation between rest and work.

In regard to the heat equivalent of muscular work it will be observed that J. C. W. performed over twice as much as either of the other subjects per kilogram of body weight and per square meter of body surface.

BODY TEMPERATURE.

In our earlier metabolism experiments attempts were made to secure data regarding the changes in body temperature. By means of an ordinary clinical thermometer a series of observations of body temperature, either axillary or sublingual, was taken by the different subjects. However useful temperatures observed in these localities may be to the clinician, it soon became evident that for experiments where a measurement of the heat production as distinguished from heat elimination is attempted and accurate measurements of actual body temperature are needed, observations of rectal temperatures would be far more reliable. Furthermore, the conditions inside the respiration chamber were not such as to afford the best facilities for personal observations on body temperature, although an attempt was made to have outside observers check the readings of the clinical thermometers as made by the subject.

Specially devised thermometer.—The success attending the use of the electrical resistance thermometers for measuring the temperature of the air in the respiration chamber[a] was such as to suggest the use of a similar form of thermometer for determining body temperatures. An especially constructed electrical thermometer was finally elaborated and used in certain of the experiments herein reported. This thermometer has been described[b] in detail, together with a large number of experiments made with it, and a brief description of it will suffice here. A coil of silk-covered copper wire is wound in a compact roll and inclosed in a silver tube about 30 millimeters long. The silver tube is provided with a hard rubber plug through which the flexible

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[a] U. S. Dept. Agr., Office of Experiment Stations Bul. 63, p. 26.

[b] Benedict and Snell, Arch. Physiol. [Pflüger], 88 (1901), p. 492. Ibid., 90 (1902), p. 33.

connecting wires pass, the inner ends of which are connected with the resistance coil, the other ends of the connecting wires being joined to a flexible cable 3–5 meters long. This system corresponds to the unknown resistance in a Wheatstone bridge. About 20 centimeters of the flexible cable above the silver tube is covered with soft rubber tubing, the ends of which are well fastened with silk and shellac. The silver tube can be inserted in the rectum to a depth of 10–14 centimeters and worn without inconvenience to the subject or without interfering with his movements about the calorimeter; indeed he finds no difficulty in wearing it for short periods when on the bicycle ergometer. The terminals of the flexible cable are connected with a Wheatstone bridge and galvanometer, used for taking observations of the temperature of the chamber. The thermometer was calibrated by use of a Beckmann thermometer, which was standardized by being placed in melting sodium sulphate. According to Richards,[a] the transition point of sodium sulphate is 32.379° C., as measured on the standard international hydrogen scale. The zero point of the Beckmann thermometer was set in such a manner as to make a range of about 6° on the scale, and thereby register the temperature from about 32.40°–38.4° C. Inasmuch as 37° C. is approximately normal body temperature, this calibration serves for the range of variation normally occurring in physiological work. The coil has a resistance of about 20 ohms, and since the resistance of pure copper increases regularly with an increase in temperature, changes in temperature of 0.01° C. can be measured readily by the deflections of the galvanometer. Owing to the local heating effect of the electric current passing through the compactly wound coil, it was found necessary to read the galvanometer ballistically.

Changes in the store of heat in the body corresponding to changes in body temperature.—It is a well-established fact that the body temperature undergoes a regular daily rythmic fluctuation, with a minimum at about 4 o'clock in the morning and a maximum in the late afternoon. It has been the usual custom in the metabolism experiments to assume that in a 24-hour experiment, especially when the subject remained under the same conditions of muscular activity or sleep at the close of the daily period, the changes of body temperature would be nearly the same from day to day, and that if the subject remained in bed until 7 o'clock in the morning, the close of the experimental day, the body temperature, and consequently the store of heat in the body, would not be widely different on different days. With an attempt to shorten the experimental period or subdivide the day it became necessary to know any variations in body temperature to allow for the possible corrections to be applied in determining the heat production. Assuming the specific heat of the body to be about 0.83, as

[a] Ztschr. Physiol. Chem., 26 (1898), p. 690.

Pembrey[a] states, the correction can readily be applied by multiplying the body weight by 0.83 and multiplying the product by the rise or fall in temperature as measured by the electrical thermometer. Obviously a change of 1° C. in the temperature of the body will cause a storage or loss of not far from 50 calories of heat from a body weighing 60 kilograms, a correction that can not legitimately be neglected in measuring the heat production during a given period.

While it is admitted by investigators that the true body temperature can best be obtained by observations in the rectum, it is by no means certain that the fluctuations of the average temperature of the body correspond exactly, though it is reasonable to suppose that they agree pretty closely, with the fluctuations of temperature of the rectum at the depth (10–14 centimeters) to which the thermometer is inserted. The most recent evidence we have on this point is that given in the experiments with the rectal thermometer mentioned above.[b] It was there found that the fluctuations in the temperature in the rectum and axilla followed each other very closely. In the corrections applied to the experiments given herewith it has been assumed that any changes in the body temperature as a whole were measured by the variations in the temperature in the rectum.

Observations of body temperature.—In the experiments in which the electrical thermometer was used observations were made at 4-minute intervals, thus giving a continuous record of the temperature of the body throughout the entire day. Temperature records were made in the fasting experiments, Nos. 36, 39, and 42, of 1 day each, and experiment No. 51 of 2 days, and in 3 of the 4 days of experiment No. 35, a rest experiment with food. In the work experiments Nos. 37, 39, and 50, the records were made during the night periods only, i. e., 13½ hours from 6.30 p. m. to 8 a. m., the thermometer being removed in the morning, when the subject began riding the bicycle, and inserted again in the evening. While it is possible for the subject to use this thermometer while riding the bicycle, it was not deemed expedient to run the risk of a local irritation or discomfort which might result from its continuous use, and might interfere with the regular continuance of the experiment. Consequently the observations during the actual hours of riding are much fewer in number, though they are singularly concordant as regards the fluctuations caused by changes in muscular activity. In each of the work experiments, Nos. 40 and 41, the records were made for one day and one night period, about 24 hours in each case. The results include, therefore, all told, the records for 5 days and nights without food, 3 days and nights with food, and with the subject at rest; 2 days of a work experiment and 11 nights after work. These records of temperature in hourly periods are given in Table 93.

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[a] Shäfer's Textbook of Physiology, Vol. I, 1898, p. 839.

[b] Arch. Physiol. [Pflüger], loc. cit.

TABLE 93.—*Summary of body temperatures by hourly periods with rectal thermometer in preliminary digestion experiments and metabolism experiments.*

Time.	Period preliminary to experiment No. 35.	Experiment No. 35.				Experiment No. 36.	Period preliminary to experiment No. 37.	Experiment No. 37.			
	Dec. 8–9.	Dec. 9–10.	Dec. 10–11.	Dec. 11–12.	Dec. 12–13.	Dec. 13–14.	Jan. 10–11.	Jan. 11–12.	Jan. 12–13.	Jan. 13–14.	Jan. 14–15.
	°C.	°C.	°C.	°C.	°C.	°C.	°C.	°C.	°C.	°C.	°C.
7 a. m.	......	36.82	36.82	36.87	......	36.95	......	36.69	36.80	36.67	36.44
8 a. m.	......	37.42	37.27	37.26	......	37.42	......	36.95	37.04	37.03	36.74
9 a. m.	......	37.42	37.59	37.56	......	37.47	......	......	......	......	......
10 a. m.	......	37.47	37.56	37.46	......	37.45	......	......	......	......	......
11 a. m.	......	37.52	37.47	37.35	......	37.46	......	......	......	......	......
12 noon	......	37.34	37.42	37.48	......	37.41	......	......	......	......	......
1 p. m.	......	37.26	37.42	37.32	......	37.35	......	......	......	......	......
2 p. m.	......	37.35	37.42	37.32	......	37.25	......	......	......	......	......
3 p. m.	......	37.34	37.58	37.50	......	37.32	......	......	......	......	......
4 p. m.	......	37.65	37.58	37.60	......	37.38	......	......	......	......	......
5 p. m.	......	37.63	37.66	37.55	......	37.34	......	......	......	......	......
6 p. m.	......	37.53	37.66	37.71	......	37.26	......	......	......	......	......
7 p. m.	......	37.57	37.50	37.53	......	37.30	37.11	37.21	37.15	37.14	36.81
8 p. m.	37.23	37.58	37.54	37.60	......	37.28	37.04	37.40	37.31	37.03	36.91
9 p. m.	37.38	37.51	37.50	37.56	......	37.26	36.85	37.16	37.29	36.92	36.84
10 p. m.	37.25	37.38	37.40	37.40	37.50	37.23	36.29	37.23	37.04	36.73	36.78
11 p. m.	37.05	37.13	37.20	37.25	37.10	37.02	36.40	36.98	36.87	36.47	36.49
12 night	36.85	36.84	36.86	......	36.92	36.57	36.28	36.70	36.54	36.44	36.30
1 a. m.	36.87	36.42	36.83	......	36.73	36.35	36.32	36.89	36.50	36.42	36.17
2 a. m.	36.97	36.38	36.82	......	36.94	36.40	36.28	36.59	36.32	36.34	36.11
3 a. m.	36.99	36.46	36.74	......	36.99	36.62	36.23	36.55	36.22	36.34	36.09
4 a. m.	36.92	36.47	36.81	......	36.77	36.74	36.31	36.48	36.29	36.42	35.98
5 a. m.	36.69	36.61	36.74	......	36.74	36.63	36.27	36.50	36.45	36.22	36.22
6 a. m.	36.63	36.65	36.73	......	36.82	36.75	36.31	36.50	36.62	36.22	36.18
7 a. m.	36.82	36.82	36.87	......	36.95	37.44	36.69	36.80	36.67	36.44	36.45

TABLE 93.—*Summary of body temperatures by hourly periods with rectal thermometer, etc.*—Continued.

Time.	Experiment No. 38.				Experiment No. 39.	Period preliminary to experiment No. 40.	Experiment No. 40.		Experiment No. 41.		Experiment No. 42.	Experiment No. 50.	Experiment No. 51.	
	Jan. 15–16.	Jan. 16–17.	Jan. 17–18.	Jan. 18–19.	Jan. 19–20.	Feb. 25–26.	Feb. 26.	Mar. 1–2.	Mar. 2.	Mar. 5–6.	Mar. 6–7.	Mar. 30–31.	Mar. 31–Apr. 1.	Apr. 1–2.
	°C.	°C.	°C.	°C.	°C.	°C.	°C.	°C.	°C.	°C.	°C.	°C.	°C.	°C.
7 a. m.	36.45	36.49	36.54	36.33	36.22		36.58		36.38		36.08		36.70	36.61
8 a. m.	36.80	36.71	36.79	36.54	36.52		36.79		36.62		36.19		36.89	36.94
9 a. m.					36.46		37.34		37.29		36.19		36.93	37.10
10 a. m.					36.50		37.29		37.28		36.22		36.73	36.92
11 a. m.					36.46		37.20		36.87		36.25		36.88	37.05
12 noon					36.43		37.20		37.05		36.23		36.98	37.18
1 p. m.					36.54		36.88		36.44		36.27		37.02	37.06
2 p. m.					36.31		36.66		36.47		36.22		37.01	36.93
3 p. m.					36.17		37.22		36.75		36.31		37.13	36.94
4 p. m.					36.42		37.25				36.26		37.25	36.89
5 p. m.					36.25			37.38			36.25		37.03	37.06
6 p. m.					36.39	36.72		37.36			36.25		37.00	37.00
7 p. m.	36.84	36.99	37.16	37.06	36.32	36.70		36.81			36.34	37.08	36.86	37.03
8 p. m.	36.99	37.30	37.09	37.09	36.38	36.83		37.02			36.31	37.14	37.08	36.76
9 p. m.	36.67	37.17	37.04	37.03	36.38	36.70		36.67			36.32	37.04	36.68	36.58
10 p. m.	36.65	37.12	36.92	36.81	36.30	36.52		36.51			36.17	36.68	36.57	36.47
11 p. m.	36.47	36.90	36.73	36.76	36.40	36.25		36.36		36.17	36.11	36.42	36.65	36.43
12 night	36.25	36.80	36.62	36.50	36.35	36.13		36.31		36.11	35.84	36.35	36.48	36.35
1 a. m.	36.30	36.83	36.66	36.47	36.42	36.02		36.19		36.17	35.81	36.48	36.40	36.37
2 a. m.	36.40	36.64	36.35	36.36	36.25	35.76		36.27		36.17	35.85	36.48	36.35	36.31
3 a. m.	36.28	36.50	36.43	36.17	36.10	35.79		36.28		36.10	35.83	36.57	36.44	36.28
4 a. m.	36.40	36.49	36.34	36.12	36.03	35.92		36.34		36.09	35.88	36.53	36.41	36.35
5 a. m.	36.42	36.42	36.19	36.03	36.22	36.07		36.22		36.05	35.90	36.48	36.48	36.49
6 a. m.	36.46	36.45	36.18	36.00	36.25	36.19		36.22		36.08	36.02	36.55	36.53	36.55
7 a. m.	36.49	36.54	36.33	36.22	36.60	36.58		36.38		36.08	36.14	36.70	36.61	36.58

The especial value of these temperature observations for the investigations herein reported is found in the corrections to be applied for storage or loss of heat from the body, as explained in detail on page 150.

Although the temperature observations have been already discussed in some detail,[a] certain important points are worthy of special emphasis in this place. While in general it may be said that especially, under like conditions of bodily activity, body temperature at a given hour of the day is nearly the same in different days, it appears that there are a few well-marked exceptions to this rule, which unquestionably would influence the value of the correction to be applied for any given period of the day. In the following statements the body temperature at 7 a. m. is all that is being considered. During the 4 days of experiment No. 35, rest with food, the temperature at 7 a. m. rose 0.13° (from 36.82 to 36.95), or 0.03° per day. During the 8 consecutive days of experiments Nos. 37 and 38 (work) the temperature at 7 a. m. fell 0.47° (from 36.69 to 36.22), or 0.06° per day. During 8 consecutive days of experiments Nos. 40 and 41 (work) the temperature again fell in this case 0.50° (from 36.58 to 36.08), or 0.06 per day. In 2 of the fasting days (experiments Nos. 36 and 39) the body was warmer at the end than at the beginning by 0.49° and 0.38°, respectively. In experiments Nos. 42 and 51 (fasting) the change is not enough to be significant. Judging by this one daily observation, i. e., at 7 a. m., there was an apparent tendency for the body temperature to be lowered progressively during work experiments and to be raised during rest experiments whether with food or without it. A study of the data recorded indicated that at 7 o'clock the body temperature is in general influenced by the rapidity of the morning rise in temperature, which usually begins 2 to 4 a. m. The data are not as yet sufficiently complete to allow any further deduction as to the apparent tendency of the body temperature to be lowered during work experiments and raised during rest experiments. Sufficient data are at hand, however, to show clearly the error in assuming that the body temperature at 7 o'clock in the morning is the same from day to day. Consequently, in accurate experiments of this nature, body temperature should be determined either by an electrical or accurate clinical thermometer in the rectum at the end of experimental periods in case an accurate estimate of the actual heat production is desired. The influence of variations of body temperature on the calculation of heat production is shown in Table 95, and is discussed in detail beyond.

HEAT PRODUCTION VERSUS HEAT ELIMINATION.

In the tables of calorimetric measurements on pages 307–333, in the Appendix, and elsewhere, the figures, when not otherwise indicated, represent the total amounts of heat brought out of the calorimeter in

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[a] Arch. Physiol. [Pflüger], loc. cit.

a given period. In other words, they represent the heat (or heat plus heat equivalent of external muscular work) eliminated from the body during that period. This, however, is not necessarily the same as the amount of heat generated—i. e., energy katabolized—during the same period, although for 24-hour periods the difference between the amount of heat eliminated and of energy transformed is negligible. Two important factors which enter as corrections, and whose influence for short periods is at times rather large, are (1) the storage or loss of heat by the body accompanying changes in body temperature, and (2) the interval of time required for the heat, after leaving the body, to make its way to the water pipes of the heat-absorber system.

Fluctuations of body temperature.—The subject of body temperature as related to storage of heat by the body has been referred to above, but in order to show its bearing upon this subject more clearly a summary table of the rise and fall of temperature during 2-hour periods is here given for the experiments with J. C. W., where observations of rectal temperature were made.

TABLE 94.—*Summary of changes of body temperature for 2-hour periods as shown by measurements with rectal thermometer—Rise* (+) *and fall* (−).

Experiment No.	Character of experiment.	7 a. m. to 9 a. m.	9 a. m. to 11 a. m.	11 a. m. to 1 p. m.	1 p. m. to 3 p. m.	3 p. m. to 5 p. m.	5 p. m. to 7 p. m.	7 p. m. to 9 p. m.
		°C.	°C.	°C.	°C.	°C.	°C.	°C.
35	Rest, with food, 1st day	+0.60	+0.10	−0.26	+0.08	+0.29	−0.06	−0.06
35	Rest, with food, 2d day	+ .77	− .12	− .05	+ .16	+ .08	− .16	.00
35	Rest, with food, 3d day	+ .69	− .21	− .03	+ .18	+ .05	− .02	+ .03
35	Rest, with food, 4th day	....	....	....	....	....	....	....
	Average for 4 days	+ .69	− .08	− .11	+ .14	+ .14	− .08	− .01
36	Rest, fasting 1 day	+ .52	− .01	− .11	− .03	+ .02	− .04	− .04
39	Rest, fasting 1 day	+ .24	.00	+ .08	− .37	+ .08	+ .07	− .04
42	Rest, fasting 1 day	+ .11	+ .06	+ .02	+ .04	− .06	+ .09	− .02
51	Rest, fasting 1st day	+ .23	− .05	+ .14	+ .11	− .10	− .17	− .18
51	Rest, fasting 2d day	+ .49	− .05	+ .01	− .12	+ .12	− .03	− .45
	Average for 5 days	+ .32	− .01	+ .03	− .07	+ .01	− .02	− .15
37	Work, with food, 1st day	....	....	....	....	....	....	− .05
37	Work, with food, 2d day	....	....	....	....	....	....	+ .14
37	Work, with food, 3d day	....	....	....	....	....	....	− .22
37	Work, with food, 4th day	....	....	....	....	....	....	+ .03
38	Work, with food, 1st day	....	....	....	....	....	....	− .17
38	Work, with food, 2d day	....	....	....	....	....	....	+ .18
38	Work, with food, 3d day	....	....	....	....	....	....	− .12
38	Work, with food, 4th day	....	....	....	....	....	....	− .03
	Average of experiments 37 and 38—8 days	....	....	....	....	....	....	− .03
40	Work, with food, 1st day	+ .76	− .14	− .32	+ .34	....	....	....
40	Work, with food, 4th day	....	....	....	....	....	+ .57	− .14
41	Work, with food, 1st day	+ .91	− .42	− .43	+ .31	....	....	....
41	Work, with food, 4th day	....	....	....	....	....	....	....
50	Work, with food, 1st day	....	....	....	....	....	....	− .04

TABLE 94.—*Summary of changes of body temperature for 2-hour periods as shown by measurements with rectal thermometer—Rise* (+) *and fall* (−)—Continued.

Experiment No.	Character of experiment.	9 p. m. to 11 p. m.	11 p. m. to 1 a. m.	1 a. m. to 3 a. m.	3 a. m. to 5 a. m.	5 a. m. to 7 a. m.	Total, 24 hours, 7 a. m. to 7 a. m.
		°C.	°C.	°C.	°C.	°C.	°C.
35	Rest, with food, 1st day	−0.38	−0.71	+0.04	+0.15	+0.21	0.00
35	Rest, with food, 2d day	− .30	− .37	− .09	.00	+ .13	+ .05
35	Rest, with food, 3d day	− .31	....	....	....	....	+ .04
35	Rest, with food, 4th day	....	− .37	+ .26	− .25	+ .21	+ .04
	Average for 4 days	− .33	− .48	+ .07	− .03	+ .18	+ .03
36	Rest, fasting 1 day	− .24	− .67	+ .27	+ .01	+ .81	+ .49
39	Rest, fasting 1 day	+ .12	+ .02	− .32	+ .12	+ .38	+ .38
42	Rest, fasting 1 day	− .21	− .30	+ .02	+ .07	+ .24	+ .06
51	Rest, fasting 1st day	− .03	− .25	+ .04	+ .04	+ .13	− .09
51	Rest, fasting 2d day	− .15	− .06	− .09	+ .21	+ .09	− .03
	Average for 5 days	− .10	− .25	− .02	+ .09	+ .33	+ .16
37	Work, with food, 1st day	− .18	− .09	− .34	− .05	+ .30	+ .11
37	Work, with food, 2d day	− .42	− .37	− .28	+ .23	+ .22	− .13
37	Work, with food, 3d day	− .45	− .05	− .08	− .12	+ .22	− .23
37	Work, with food, 4th day	− .35	− .32	− .08	+ .13	+ .23	+ .01
38	Work, with food, 1st day	− .20	− .17	− .02	+ .14	+ .07	+ .04
38	Work, with food, 2d day	− .27	− .07	− .33	− .08	+ .12	+ .05
38	Work, with food, 3d day	− .31	− .07	− .23	− .24	+ .14	− .21
38	Work, with food, 4th day	− .27	− .29	− .30	− .14	+ .19	− .11
	Average of expe iments 37 and 38—8 days	− .31	− .18	− .21	− .03	+ .18	− .06
40	Work, with food, 1st day	....	....	....	....	....	− .05
40	Work, with food, 4th day	− .31	− .17	+ .09	− .06	+ .16	− .05
41	Work, with food, 1st day	....	....	....	....	....	− .08
41	Work, with food, 4th day	....	.00	− .07	+ .05	+ .03	− .07
50	Work, with food, 1st day	− .62	+ .06	+ .09	− .09	+ .22	....

From the data summarized above it will be seen that changes of 0.5° C. or more in 2 hours are not infrequent, and in one instance a change of 0.91° C. is recorded, although the net change in the 24 hours from 7 a. m. to 7 a. m. seldom exceeds 0.10° C.

Gain or loss of body heat.—According to Pembrey's[a] estimate the specific heat of the human body is not far from 0.83. The subject of these experiments weighed from 75 to 80 kilograms, his average weight being about 77 kilograms, so that a rise or fall of 0.1° C. in the temperature of his body would correspond to a gain or loss of ($0.1\times0.83\times77=$) 6.4 calories, or 32 calories for a change of 0.5° C. That is to say, if the body cools 0.5° during a given period, 32 calories of heat will be eliminated and measured by the calorimeter in excess of the amount produced in the same period, and if the temperature rises the corresponding amount of heat produced will be stored

[a] Schäfer's Text-book of Physiology, Vol. I, 1898, p. 839.

and not measured. In the night periods, when the amount of heat measured is relatively small, this storage or loss of heat may represent an appreciable proportion of the total amount, as will be seen in Table 95.

Correction for heat absorbed by bed and bedding.—When the subject leaves his bed (at 7 a. m.) the bedding, etc., which has been warmed by his body, cools down to the temperature of the calorimeter, and when he retires (at 11 p. m.) the radiation of heat from the body is impeded while part of the bedding is being warmed to a temperature near that of the body. The result of this is that the heat measurement for the period 7 a. m. to 9 a. m. is too high, and that from 11 p. m. to 1 a. m. is too low. This increase or decrease in the amount of heat radiated affects correspondingly the amount of heat carried out of the chamber by the water current and is immediately noticed by the observer outside the chamber, although the available data are insufficient for estimating its exact amount. A tentative figure, which is, unfortunately, but little better than a rough estimate, is 30 calories for the amount of heat stored in the bedding at night and given off in the morning. This figure was obtained by working backward from the thermal quotient (see beyond), and thus finding what figure would give the most uniform results when added (algebraically) to the values for periods 7 a. m. to 9 a. m. and 11 p. m. to 1 p. m., and comparing the figures thus obtained with the estimated amount of heat required to raise the bedding and inclosed air from 20° to 35°.

Total heat production—Amount of energy katabolized.—Applying the above corrections for the heat stored or lost by the bedding and for changes in body temperature, tentative values are obtained for the amounts of heat produced. These corrections have been applied in all experiments in which the measurements of body temperature were made with the rectal thermometer (Nos. 35–42, 50, and 51) as shown in detail in Table 95. The table also includes column (f), which shows the amount of carbon dioxid produced by the body, and column (g), which shows the so-called "carbon dioxid thermal quotient"—that is, the ratio of heat produced to carbon dioxid produced. These data are discussed later (page 168).

TABLE 95.—*Corrected amount of heat produced and ratio of heat to carbon dioxid.*

Period.	(*a*) Rise (+) or fall (−) of body temperature.	(*b*) Gain (+) or loss (−) of body heat,* 0.83 $a \times w$.	(*c*) Assumed correction for bed and bedding.	(*d*) Heat eliminated (measured).	(*e*) Corrected amount of heat produced, $b+c+d$.	(*f*) Carbon dioxid eliminated.	(*g*) Carbon dioxid per 100 calories of energy, 100 $f \div e$.
Experiment No. 35, rest, with food.	° *C.*	*Calories.*	*Calories.*	*Calories.*	*Calories.*	*Grams.*	*Grams.*
7 a. m. to 9 a. m	+0.69	+43.5	−30	253.4	266.9	90.2	33.8
9 a. m. to 11 a m	− .08	− 5.0	....	232.9	227.9	73.6	32.3
11 a. m. to 1 p. m	− .11	− 7.0	....	210.3	203.3	66.6	32.8
Total, 6 hours	+ .50	+31.5	−30	696.6	698.1	230.4	33.0
1 p. m. to 3 p. m	+ .14	+ 8.8	....	231.3	240.1	85.9	35.8
3 p. m. to 5 p. m	+ .14	+ 8.8	....	224.8	233.6	70.9	30.4
5 p. m. to 7 p. m	− .08	− 5.0	....	216.8	211.8	75.2	35.5
Total, 6 hours	+ .20	+12.6	....	672.9	685.5	232.0	33.9
Total, 12 hours	+ .70	+44.1	−30	1,369.5	1,383.6	462.4	33.4
7 p. m. to 9 p. m	− .01	− .6	....	219.8	219.2	67.6	30.8
9 p. m. to 11 p. m	− .33	−20.8	....	213.0	192.2	69.5	36.2
11 p. m. to 1 a. m	− .48	−30.3	+30	145.2	144.9	59.5	41.1
Total, 6 hours	− .82	−51.7	+30	578.0	556.3	196.6	35.3
1 a. m. to 3 a. m	+ .07	+ 4.4	....	154.9	159.3	50.2	31.5
3 a. m. to 5 a. m	− .03	− 1.9	....	140.4	138.5	51.9	37.5
5 a. m. to 7 a. m	+ .18	+11.4	....	154.2	165.6	51.0	30.8
Total, 6 hours	+ .22	+13.9	....	449.5	463.4	153.1	33.0
Total, 12 hours	− .60	−37.8	+30	1,027.5	1,019.7	349.7	34.3
Total, 24 hours	+ .10	+ 6.3	....	2,397.0	2,403.3	812.1	33.8
Experiment No. 36, fasting.							
7 a. m. to 9 a. m	+ .52	+31.9	−30	237.5	239.4	76.4	31.9
9 a. m. to 11 a. m	− .01	− .6	....	216.9	216.3	67.8	31.4
11 a. m. to 1 p. m	− .11	− 6.7	....	202.5	195.8	58.6	29.9
Total, 6 hours	+ .40	+24.6	−30	656.9	651.5	202.8	31.1
1 p. m. to 3 p. m	− .03	− 1.8	....	212.7	210.9	66.6	31.6
3 p. m. to 5 p. m	+ .02	+ 1.2	....	199.3	200.5	59.2	29.5
5 p. m. to 7 p. m	− .04	− 2.5	....	198.9	196.4	60.2	30.7
Total, 6 hours	− .05	− 3.1	....	610.9	607.8	186.0	30.6
Total, 12 hours	+ .35	+21.5	−30	1,267.8	1,259.3	388.8	30.9
7 p. m. to 9 p. m	− .04	− 2.5	....	202.3	199.8	63.6	31.8
9 p. m. to 11 p. m	− .24	−14.7	....	193.1	178.4	57.6	32.3
11 p. m. to 1 a. m	− .67	−41.1	+30	131.5	120.4	50.0	41.5
Total, 6 hours	− .95	−58.3	+30	526.9	498.6	171.2	34.3
1 a. m. to 3 a. m	+ .27	+16.6	....	131.6	148.2	49.0	33.1
3 a. m. to 5 a. m	+ .01	+ .6	....	149.3	149.9	45.9	30.6
5 a. m. to 7 a. m	+ .81	+49.7	....	177.2	226.9	56.2	24.8
Total, 6 hours	+1.09	+66.9	....	458.1	525.0	151.1	28.8
Total, 12 hours	+ .14	+ 8.6	+30	985.0	1,023.6	322.3	31.5
Total, 24 hours	+ .49	+30.1	....	2,252.8	2,282.9	711.1	31.1

*The figures in this column are obtained by multiplying together the specific heat of the body (taken as 0.83), the body weight, and the change in temperature. For the record of body weight, see Table 127, of Appendix.

TABLE 95.—*Corrected amount of heat produced and ratio of heat to carbon dioxid*—Cont'd.

Period.	(*a*) Rise (+) or fall (−) of body temperature.	(*b*) Gain (+) or loss (−) of body heat,* $0.83 a \times w$.	(*c*) Assumed correction for bed and bedding.	(*d*) Heat eliminated (measured).	(*e*) Corrected amount of heat produced, $b+c+d$.	(*f*) Carbon dioxid eliminated.	(*g*) Carbon dioxid per 100 calories of energy, $100 f \div e$.
Experiment No. 39, fasting.	° *C.*	*Calories.*	*Calories.*	*Calories.*	*Calories.*	*Grams.*	*Grams.*
7 a. m. to 9 a. m	+0.24	+14.5	−30	218.8	203.3	66.5	32.7
9 a. m. to 11 a. m	0.0	....	....	199.2	199.2	62.4	31.3
11 a. m. to 1 p. m	+ .08	+ 4.9	....	163.3	168.2	51.2	30.4
Total, 6 hours	+ .32	+19.4	−30	581.3	570.7	180.1	31.6
1 p. m. to 3 p. m	− .37	−22.4	....	186.7	164.3	56.5	34.4
3 p. m. to 5 p. m	+ .08	+ 4.9	....	161.6	166.5	54.5	32.7
5 p. m. to 7 p. m	+ .07	+ 4.2	....	169.0	173.2	50.0	28.9
Total, 6 hours	− .22	−13.3	....	517.3	504.0	161.0	32.0
Total, 12 hours	+ .10	+ 6.1	−30	1,098.6	1,074.7	341.1	31.7
7 p. m. to 9 p. m	− .04	− 2.4	....	143.1	140.7	65.5	46.5
9 p. m. to 11 p. m	+ .12	+ 7.3	....	159.6	166.9	50.8	30.4
11 p. m. to 1 a. m	+ .02	+ 1.2	+30	164.7	195.9	51.8	26.4
Total, 6 hours	+ .10	+ 6.1	+30	467.4	503.5	168.1	33.4
1 a. m. to 3 a. m	− .32	−19.4	....	160.6	141.2	42.4	30.0
3 a. m. to 5 a. m	+ .12	+ 7.3	....	127.7	135.0	45.2	33.5
5 a. m. to 7 a. m	+ .38	+23.0	....	172.6	195.6	52.1	26.6
Total, 6 hours	+ .18	+10.9	....	460.9	471.8	139.7	29.6
Total, 12 hours	+ .28	+17.0	+30	928.3	975.3	307.8	31.6
Total, 24 hours	+ .38	+23.1	....	2,026.9	2,050.0	648.9	31.7
Experiment No. 42, fasting.							
7 a. m. to 9 a. m	+ .11	+ 7.0	−30	225.9	202.9	75.1	37.0
9 a. m. to 11 a. m	+ .06	+ 3.8	....	147.7	151.5	49.1	32.4
11 a. m. to 1 p. m	+ .02	+ 1.3	....	148.1	149.4	52.7	35.3
Total, 6 hours	+ .19	+12.1	−30	521.7	503.8	176.9	35.1
1 p. m. to 3 p. m	+ .04	+ 2.5	....	163.1	165.6	51.4	31.0
3 p. m. to 5 p. m	− .06	− 3.8	....	158.1	154.3	50.6	32.8
5 p. m. to 7 p. m	+ .09	+ 5.7	....	166.4	172.1	53.7	31.2
Total, 6 hours	+ .07	+ 4.4	....	487.6	492.0	155.7	31.7
Total, 12 hours	+ .26	+16.5	−30	1,009.3	995.8	332.6	33.4
7 p. m. to 9 p. m	− .02	− 1.3	....	160.0	158.7	51.9	32.7
9 p. m. to 11 p. m	− .21	−13.3	....	181.5	168.2	48.0	28.5
11 p. m. to 1 a. m	− .30	−19.1	+30	137.7	148.6	47.9	32.2
Total, 6 hours	− .53	−33.7	+30	479.2	475.5	147.8	31.1
1 a. m. to 3 a. m	+ .02	+ 1.3	....	146.8	148.1	44.6	30.1
3 a. m. to 5 a. m	+ .07	+ 4.5	....	144.2	148.7	44.8	30.1
5 a. m. to 7 a. m	+ .24	+15.2	....	166.6	181.8	49.9	27.5
Total, 6 hours	+ .33	+21.0	....	457.6	478.6	139.3	29.1
Total, 12 hours	−.20	−12.7	+30	936.8	954.1	287.1	30.1
Total, 24 hours	+ .06	+ 3.8	....	1,946.1	1,949.9	619.7	31.8

* The figures in this column are obtained by multiplying together the specific heat of the body (taken as 0.83), the body weight, and the change in temperature. For the record of body weight, see Table 127, of Appendix.

TABLE 95.—*Corrected amount of heat produced and ratio of heat to carbon dioxid*—Cont'd.

Period.	(a) Rise (+) or fall (−) of body temperature.	(b) Gain (+) or loss (−) of body heat,* 0.83 $a \times w$.	(c) Assumed correction for bed and bedding.	(d) Heat eliminated (measured).	(e) Corrected amount of heat produced, $b+c+d$.	(f) Carbon dioxid eliminated.	(g) Carbon dioxid per 100 calories of energy, $100 f \div e$.
Experiment No. 37, work, carbohydrate diet.	° C.	Calories.	Calories.	Calories.	Calories.	Grams.	Grams.
7 a. m. to 9 a. m	+0.80	+50.0	−30	470.2	490.2	179.3	36.6
9 a. m. to 11 a. m	− .20	−12.5	....	698.9	686.4	242.1	35.3
11 a. m. to 1 p. m	− .30	−18.7	....	637.1	618.4	219.8	35.5
Total, 6 hours	+ .30	+18.8	−30	1,806.2	1,795.0	641.2	35.7
1 p. m. to 3 p. m	+ .30	+18.7	....	495.4	514.1	179.3	34.9
3 p. m. to 5 p. m	+ .20	+12.5	....	725.1	737.6	243.3	33.0
5 p. m. to 7 p. m	− .37	−23.1	....	589.1	566.0	204.2	36.1
Total, 6 hours	+ .13	+ 8.1	....	1,809.6	1,817.7	626.8	34.5
Total, 12 hours	+ .43	+26.9	−30	3,615.8	3,612.7	1,268.0	35.1
7 p. m. to 9 p. m	− .02	− 1.3	....	276.9	275.6	95.6	34.7
9 p. m. to 11 p. m	− .35	−21.9	....	269.3	247.4	87.7	35.5
11 p. m. to 1 a. m	− .21	−13.1	+30	141.5	158.4	56.3	35.5
Total, 6 hours	− .58	−36.3	+30	687.7	681.4	239.6	35.2
1 a. m. to 3 a. m	− .20	−12.5	....	163.1	150.6	50.6	33.6
3 a. m. to 5 a. m	+ .05	+ 3.1	....	143.8	146.9	46.1	31.4
5 a. m. 7 a. m	+ .24	+15.0	....	153.8	168.8	51.4	30.5
Total, 6 hours	+ .09	+ 5.6	....	460.7	466.3	148.1	31.8
Total, 12 hours	− .49	−30.7	+30	1,148.4	1,147.7	387.7	33.8
Total, 24 hours	− .06	− 3.8	....	4,764.2	4,760.4	1,655.7	34.8
Experiment No. 40, work, carbohydrate diet.							
7 a. m. to 9 a. m	+ .76	+47.4	−30	487.6	505.0	183.0	36.2
9 a. m. to 11 a. m	− .14	− 8.7	....	810.0	801.3	296.7	37.0
11 a. m. to 1 p. m	− .32	−20.0	....	721.1	701.1	245.9	35.1
Total, 6 hours	+ .30	+18.7	−30	2,018.7	2,007.4	725.6	36.1
1 p. m. to 3 p. m	+ .34	+21.2	....	555.7	576.9	204.9	35.5
3 p. m. to 5 p. m	+ .31	+19.3	....	806.6	825.9	288.8	35.0
5 p. m. to 7 p. m	− .57	−35.5	....	658.1	622.6	219.8	35.3
Total, 6 hours	+ .08	+ 5.0	....	2,020.4	2,025.4	713.5	35.2
Total, 12 hours	+ .38	+23.7	−30	4,039.1	4,032.8	1,439.1	35.7
7 p. m. to 9 p. m	− .14	− 8.7	....	281.7	273.0	106.8	39.1
9 p. m. to 11 p. m	− .31	−19.3	....	251.4	232.1	84.8	36.5
11 p. m. to 1 a. m	− .17	−10.6	+30	167.5	186.9	61.2	32.8
Total, 6 hours	− .62	−38.6	+30	700.6	692.0	252.8	36.5
1 a. m. to 3 a. m	+ .09	+ 5.6	....	162.4	168.0	53.3	31.7
3 a. m. to 5 a. m	− .06	− 3.7	....	152.0	148.3	50.1	33.8
5 a. m. to 7 a. m	+ .16	+ 9.9	....	168.9	178.8	54.5	30.5
Total, 6 hours	+ .19	+11.8	....	483.3	495.1	157.9	31.9
Total, 12 hours	− .43	−26.8	+30	1,183.9	1,187.1	410.7	34.6
Total, 24 hours	− .05	− 3.1	....	5,223.0	5,219.9	1,849.8	35.4

*The figures in this column are obtained by multiplying together the specific heat of the body (taken as 0.83), the body weight, and the change in temperature. For the record of body weight, see Table 127, of Appendix.

TABLE 95.—*Corrected amount of heat produced and ratio of heat to carbon dioxid*—Cont'd.

Period.	(*a*) Rise (+) or fall (−) of body temperature.	(*b*) Gain (+) or loss (−) of body heat,* 0.83 $a \times w$.	(*c*) Assumed correction for bed and bedding.	(*d*) Heat eliminated (measured).	(*e*) Corrected amount of heat produced, $b+c+d$.	(*f*) Carbon dioxid eliminated.	(*g*) Carbon dioxid per 100 calories of energy, 100 $f \div e$.
Experiment No. 38, work, fat diet.	° C.	*Calories.*	*Calories.*	*Calories.*	*Calories.*	*Grams.*	*Grams.*
7 a. m. to 9 a. m	+0.80	+50.0	−30	425.1	445.1	154.4	34.7
9 a. m. to 11 a. m	− .20	−12.5	....	656.5	644.0	209.6	32.6
11 a. m. to 1 p. m	− .30	−18.7	....	584.6	565.9	189.2	33.4
Total, 6 hours	+ .30	+18.8	−30	1,666.2	1,655.0	553.2	33.4
1 p. m. to 3 p. m	+ .30	+18.7	....	474.5	493.2	160.6	32.6
3 p. m. to 5 p. m	+ .30	+18.8	....	671.0	689.8	220.1	31.9
5 p. m. to 7 p. m	− .34	−21.3	....	526.9	505.6	182.1	36.0
Total, 6 hours	+ .26	+16.2	....	1,672.4	1,688.6	562.8	33.3
Total, 12 hours	+ .56	+35.0	−30	3,338.6	3,343.6	1,116.0	33.4
7 p. m. to 9 p. m	− .04	− 2.5	....	263.4	260.9	81.6	31.3
9 p. m. to 11 p. m	− .26	−16.2	....	247.4	231.2	74.0	32.0
11 p. m. to 1 a. m	− .15	− 9.4	+30	151.3	171.9	55.9	32.5
Total, 6 hours	− .45	−28.1	+30	662.1	664.0	211.5	31.9
1 a. m. to 3 a. m	− .22	−13.7	....	172.9	159.2	51.6	32.4
3 a. m. to 5 a. m	− .08	− 5.0	....	147.1	142.1	45.5	32.0
5 a. m. to 7 a. m	+ .13	+ 8.1	....	156.1	164.2	49.2	30.0
Total, 6 hours	− .17	−10.6	....	476.1	465.5	146.3	31.4
Total, 12 hours	− .62	−38.7	+30	1,138.2	1,129.5	357.8	31.7
Total, 24 hours	− .06	− 3.7	....	4,476.8	4,473.1	1,473.8	32.9
Experiment No. 41, work, fat diet.							
7 a. m. to 9 a. m	+ .91	+56.9	−30	502.2	529.1	177.1	33.5
9 a. m. to 11 a. m	− .42	−26.3	....	831.1	804.8	269.8	33.5
11 a. m. to 1 p. m	− .43	−26.9	....	732.4	705.5	223.0	31.6
Total, 6 hours	+ .06	+ 3.7	−30	2,065.7	2,039.4	669.9	32.8
1 p. m. to 3 p. m	+ .31	+19.4	....	540.8	560.2	189.8	33.9
3 p. m. to 5 p. m	+ .20	+12.5	....	783.7	796.2	248.2	31.2
5 p. m. to 7 p. m	− .21	−13.1	....	643.5	630.4	214.2	34.0
Total, 6 hours	+ .30	+18.8	....	1,968.0	1,986.8	652.2	32.8
Total, 12 hours	+ .36	+22.5	−30	4,033.7	4,026.2	1,322.1	32.8
7 p. m. to 9 p. m	− .14	− 8.8	....	272.5	263.7	81.9	31.1
9 p. m. to 11 p. m	− .20	−12.5	....	258.3	245.8	74.6	30.4
11 p. m. to 1 a. m	0.0	0.0	+30	166.1	196.1	60.0	30.6
Total, 6 hours	− .34	−21.3	+30	696.9	705.6	216.5	30.7
1 a. m. to 3 a. m	− .07	− 4.4	....	170.9	166.5	54.2	32.5
3 a. m. to 5 a. m	− .05	− 3.1	....	158.5	155.4	49.0	31.5
5 a. m. to 7 a. m	+ .03	+ 1.9	....	181.7	183.6	51.7	28.2
Total, 6 hours	− .09	− 5.6	....	511.1	505.5	154.9	30.6
Total, 12 hours	− .43	−26.9	+30	1,208.0	1,211.1	371.4	30.7
Total, 24 hours	− .07	− 4.4	....	5,241.7	5,237.3	1,693.5	32.3

*The figures in this column are obtained by multiplying together the specific heat of the body (taken as 0.83), the body weight, and the change in temperature. For the record of body weight, see Table 127, of Appendix.

TABLE 95.—*Corrected amount of heat produced and ratio of heat to carbon dioxid*—Cont'd.

Period.	(*a*) Rise (+) or fall (−) of body temperature.	(*b*) Gain (+) or loss (−) of body heat,* 0.83 *a*×*w*.	(*c*) Assumed correction for bed and bedding.	(*d*) Heat eliminated (measured).	(*e*) Corrected amount of heat produced, *b*+*c*+*d*.	(*f*) Carbon dioxid eliminated.	(*g*) Carbon dioxid per 100 calories of energy, 100 *f*÷*e*.
Experiment No. 50, five hours' work, one meal.	° *C.*	*Calories.*	*Calories.*	*Calories.*	*Calories.*	*Grams.*	*Grams.*
7 a. m. to 9 a. m	+0.75	+49.8	−30	468.1	487.9	167.9	34.4
9 a. m. to 11 a. m	− .07	− 4.7	....	749.9	745.2	247.5	33.2
11 a. m. to 1 p. m	− .30	−19.9	....	701.4	681.5	249.4	36.6
Total, 6 hours	+ .38	+25.2	−30	1,919.4	1,914.6	664.8	34.7
1 p. m. to 3 p. m	+ .30	+19.9	....	453.3	473.2	146.3	30.9
3 p. m. to 5 p. m	− .30	−19.9	....	344.9	325.0	113.6	35.0
5 p. m. to 7 p. m	....	....	....	256.9	256.9	80.7	31.4
Total, 6 hours	....	....	....	1,055.1	1,055.1	340.6	32.3
Total, 12 hours	+ .38	+25.2	−30	2,974.5	2,969.7	1,005.4	33.9
7 p. m. to 9 p. m	− .04	− 2.7	....	277.5	274.8	80.1	29.2
9 p. m. to 11 p. m	− .62	−41.1	....	248.3	207.2	73.6	35.5
11 p. m. to 1 a. m	+ .06	+ 4.0	+30	143.8	177.8	59.6	33.5
Total, 6 hours	− .60	−39.8	+30	669.6	659.8	213.3	32.3
1 a. m. to 3 a. m	+ .09	+ 6.0	....	168.1	174.1	50.6	29.1
3 a. m. to 5 a. m	− .09	− 6.0	....	171.6	165.6	51.8	31.3
5 a. m. to 7 a. m	+ .22	+14.6	....	150.2	164.8	53.5	32.5
Total, 6 hours	+ .22	+14.6	....	489.9	504.5	155.9	30.9
Total, 12 hours	− .38	−25.2	+30	1,159.5	1,164.3	369.2	31.7
Total, 24 hours	0.0	0.0	....	4,134.0	4,134.0	1,374.6	33.3
Experiment No. 51, fasting.							
7 a. m. to 9 a. m	+ .36	+23.5	−30	268.0	261.5	72.5	27.7
9 a. m. to 11 a. m	− .05	− 3.3	....	203.3	200.0	62.0	31.0
11 a. m. to 1 p. m	+ .08	+ 5.2	....	199.1	204.3	59.7	29.2
Total, 6 hours	+ .39	+25.4	−30	670.4	665.8	194.2	29.2
1 p. m. to 3 p. m	0.0	0.0	....	205.4	205.4	62.2	30.3
3 p. m. to 5 p. m	0.0	0.0	....	193.9	193.9	57.1	29.5
5 p. m. to 7 p. m	− .10	− 6.5	....	200.1	193.6	60.7	31.3
Total, 6 hours	− .10	− 6.5	....	599.4	592.9	180.0	30.4
Total, 12 hours	+ .29	+18.9	−30	1,269.8	1,258.7	374.2	29.7
7 p. m. to 9 p. m	− .32	−20.9	....	227.6	206.7	64.2	31.1
9 p. m. to 11 p. m	− .09	− 5.9	....	219.0	213.1	55.6	26.1
11 p. m. to 1 a. m	− .15	− 9.7	+30	167.7	188.0	54.7	29.1
Total, 6 hours	− .56	−36.5	+30	614.3	607.8	174.5	28.7
1 a. m. to 3 a. m	− .03	− 2.0	....	151.6	149.6	47.8	32.0
3 a. m. to 5 a. m	+ .13	+ 8.5	....	158.3	166.8	50.8	30.5
5 a. m. to 7 a. m	+ .11	+ 7.2	....	161.3	168.5	53.1	31.5
Total, 6 hours	+ .21	+13.7	....	471.2	484.9	151.7	31.3
Total, 12 hours	− .35	−22.8	+30	1,085.5	1,092.7	326.2	29.9
Total, 24 hours	− .06	− 3.9	....	2,355.3	2,351.4	700.4	29.8

*The figures in this column are obtained by multiplying together the specific heat of the body (taken as 0.83), the body weight, and the change in temperature. For the record of body weight, see Table 127, of Appendix.

ESTIMATES OF AMOUNTS OF OXYGEN CONSUMED.

When the amounts of oxygen which the body takes from the inhaled air and uses for oxidation (or perhaps stores for later use) is learned either by direct determination or estimate, it is possible, by taking into account the amounts of carbon dioxid excreted in the respired air, to compute the respiratory quotient. In the metabolism experiments thus far made with the respiration calorimeter the oxygen consumption has not been measured directly.[a] However, the amounts of oxygen may be estimated from the quantities and composition of the food, drink, and excreta according to a method elaborated by E. B. Rosa.[b] The procedure may be explained by the following example, in which the oxygen consumed in experiment No. 35 is calculated, the necessary data being found in the tables on pages 46, 51, and in the Appendix, which give the results of the experiment. The several steps are:

First, the income of nitrogen, carbon, hydrogen, oxygen, and of ash for the 4 days is calculated from the total amount of food and drink by the use of analytical data and chemical formulas, in the following way: The total amount of food consumed during the 4 days of the experiment was 5,580.0 grams, of which 3,687.6 grams was water and 1,892.4 grams solids. By the usual method the water in the food is calculated to contain 412.6 grams of hydrogen and 3,275.0 grams of oxygen. The elementary analyses of the solid (water free) food material showed that it contained 64.2 grams of nitrogen, 944.4 grams of carbon, 139.3 grams of hydrogen, 695.5 grams of oxygen (by difference) and 49 grams of mineral matter or ash. The water drunk or taken in the form of coffee amounted to 4,000.0 grams, equivalent to 447.6 grams hydrogen and 3,552.4 grams oxygen. The total income in food and drink, during the 4 days, therefore, amounted to 9,580 grams and was composed of 64.2 grams of nitrogen, 944.4 grams of carbon, 999.5 grams of hydrogen, 49.0 grams of ash, and 7,522.9 grams of oxygen.

Similarly the elementary composition of the outgo is ascertained as follows:

The total amount of feces excreted during the 4 days was 395.3 grams, of which 310.7 grams was water and 84.6 grams solid matter. This amount of water was equivalent to 34.8 grams hydrogen and 275.9 grams oxygen. Analysis of the dry matter of the feces showed that it contained a total of 4.9 grams nitrogen, 39.9 grams carbon, 5.7 grams hydrogen, 15.0 grams ash, and (by difference) 19.1 grams oxygen.

The amount of urine excreted was 5,683.4 grams, consisting of 5,455.5 grams of water and 227.9 grams of solids. The water was

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[a] Arrangements for the direct determination of oxygen have been lately devised and the results of experiments including this factor await publication.

[b] Phys. Rev., **10** (1900), p. 129.

composed of 610.5 grams of hydrogen and 4,845.0 grams of oxygen. Analyses showed that the solids contained 63.4 grams nitrogen, 47.2 grams carbon, 11.9 grams hydrogen, 24.9 grams ash, and (by difference) 80.5 grams oxygen. The estimation by difference of oxygen in the water-free substance of the food, urine, and feces is of course crude, and is one of the weak points of the method.

The water of respiration and perspiration, as determined by the respiration calorimeter, amounted to 3,524.0 grams, of which 394.3 grams was hydrogen and 3,129.7 grams oxygen. The total carbon dioxid exhaled was found in like manner to be 3,248.3 grams, equivalent to 886.0 grams carbon and 2,362.3 grams oxygen. The total outgo was accordingly 68.3 grams nitrogen, 913.1 grams carbon, 1,057.2 grams hydrogen, 10,712.5 grams oxygen, and 39.9 grams ash.

The difference between income and outgo represents the gain or loss of body material. In the above example the outgo of everything except mineral matter was greater than the income, the total loss being 3,271.0 grams, made up of 4.1 grams nitrogen, 28.7 grams carbon, 57.7 grams hydrogen and 3,189.6 grams oxygen. The gain of ash, i. e., mineral matter, was 9.1 grams.

Assuming body protein to contain 16 per cent nitrogen, 53 per cent carbon, 7 per cent hydrogen, 23 per cent oxygen, and 1 per cent sulphur, the loss of 4.1 grams of nitrogen would be equivalent to a loss of 25.6 grams of body protein, containing 13.6 grams carbon, 1.8 grams hydrogen, 5.9 grams oxygen, and 0.2 gram sulphur, which is taken as ash.

As just stated, the outgo of carbon exceeded the income by 28.7 grams, of which 13.6 grams was in the protein lost from the body. This leaves 15.1 grams of carbon to be accounted for. Such carbon might belong to either fat or glycogen (carbohydrates) lost from the body. It is here assumed (see page 174) that the amount of glycogen in the body is the same, from day to day, at 7 a. m., the hour when all experiments begin and end. On this assumption the 15.1 grams of carbon was all lost in the form of body fat. The above reasoning and assumption may be erroneous; if it is, it introduces an error into the calculations.

The composition of body fat, as determined in this laboratory by Benedict and Osterberg,[a] is 76.08 per cent carbon, 11.80 per cent hydrogen, and, by difference, 12.12 per cent oxygen. Thus the 15.1 grams of carbon lost would correspond to 19.8 grams of body fat, containing 2.3 grams of hydrogen and 2.4 grams of oxygen.

A loss of 53.6 grams of hydrogen now remains to be accounted for, and this is attributed to a loss of water from the body, equivalent to 479 grams, containing 425.4 grams of oxygen.

Since the body gained 9.1 grams of mineral matter and is assumed

[a] Amer. Jour. Physiol., 4 (1900), p. 74.

to have lost 0.2 gram as sulphur in the protein lost, its actual gain from the food was calculated to be 9.3 grams ash.

The total income of oxygen from food and drink as above calculated is 7,522.9 grams. The total outgo in the excreta is 10,712.5 grams. The difference is 3,189.6 grams, of which 433.7 grams was contained in the protein, fat, and water lost from the body. This leaves 2,755.9 grams of oxygen which the body gave off over and above that which it secured in food and drink and supplied from its accumulated store of material. If the calculations and assumptions are correct this is the amount it took from the air. The above calculations are here summarized in Table 96.

TABLE 96.—*Estimated income and outgo of matter in metabolism experiment No. 35, with J. C. W., at rest and on ordinary diet—Total amounts for four days.*

Materials.	Weight.	Nitrogen.	Carbon.	Hydrogen.	Oxygen (estimated).	Ash.
Income.	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
Water in food	3,687.6	....	....	412.6	3,275.0	....
Solids in food	1,892.4	64.2	944.4	139.3	695.5	49.0
Water of drink	4,000.0	....	....	447.6	3,552.4	....
Total	9,580.0	64.2	944.4	999.5	7,522.9	49.0
Outgo.						
Water in feces	310.7	....	....	34.8	275.9	....
Solids in feces	84.6	4.9	39.9	5.7	19.1	15.0
Water in urine	5,455.5	....	....	610.5	4,845.0	....
Solids in urine	227.9	63.4	47.2	11.9	80.5	24.9
Water of respiration, etc	3,524.0	....	....	394.3	3,129.7	....
CO_2 of respiration, etc	3,248.3	....	886.0	....	2,362.3	....
Total	12,851.0	68.3	973.1	1,057.2	10,712.5	39.9
Outgo greater (+) or less (−) than income.	+3,271.0	+4.1	+28.7	+57.7	+3,189.6	−9.1
Body material.						
Protein lost, estimated to furnish	− 25.6	−4.1	−13.6	− 1.8	− 5.9	− .2
Fat lost, estimated to furnish	− 19.8	....	−15.1	− 2.3	− 2.4	....
Water lost, estimated to furnish	− 479.0	....	....	−53.6	− 425.4	....
Ash constituents gained, furnished	+ 9.3	....	....	....	....	+9.3
Oxygen from air	2,755.9	....	....	....	2,755.9	....

Comparison of income and outgo—Body weight—Errors in method.—As regards total materials, the sum of the weights of the excreta (outgo) is 12,851 grams, and the sum for the food and drink (income) 9,580 grams. The difference, 3,271 grams, is then the excess of excreta over food plus drink. This excess is made up of two factors, body material lost and oxygen taken from the air. The total body material (protein, fat, and water) estimated to be lost is 524.4 grams, from which is to be deducted an estimated gain of 9.3 grams of mineral matters, making the net loss of body weight 515.1 grams. If we add to this the 2,755.9 grams of oxygen which the body is estimated to have taken from the air and used to make up the sum total of

the excreta, we have the 3,271 grams by which the estimated outgo exceeds the income.

The comparison of income and outgo may be put in another way. The food, drink, and oxygen may be called net income. The sum of these and the body material which was used with them to make up the total output may be called the gross or total income, which should equal the total outgo. The computation will then be:

	Grams.
Food and drink	9,580.0
Oxygen	2,755.9
Net income	12,335.9
Body material used	515.1
Total income	12,851.0
Total outgo	12,851.0

This agreement of estimated income and outgo might be taken, at first sight, as a proof of the accuracy of the figures. A moment's reflection, however, will show that it certifies to nothing more than the accuracy of the arithmetical computations; but it does seem to be a check upon the accuracy of the recorded body weight.

The estimated loss in body weight for the 4 days of the experiment is 515.1 grams. The feces passed during the 4 days of the experiment weighed 350.7 grams, while the feces actually belonging to the experiment, as shown by charcoal markers, weighed 395.3 grams. The difference, 44.6 grams, subtracted from the 515.1 grams leaves a net estimated loss of weight of 470.5 grams.

The subject weighed himself at stated times each day on a small platform scale in the respiration chamber. His record of the weights at the beginning and at the end of the experiment (at 7 a. m.) shows a loss of 250 grams, leaving a discrepancy of 220.5 grams. This discrepancy may be due to (1) errors in the record of body weight at the beginning or end of the experiment,[a] (2) differences in the amounts of carbohydrates (glycogen) in the body at the beginning and end, (3) possible differences in the amounts of oxygen stored at beginning and end, (4) errors in analyses of food materials and excreta, (5) errors in assumed composition of body material, (6) errors in the determinations of carbon dioxid and water and air current, and (7) possible minute errors due to ignoring the composition of the ash. Considering that the discrepancy represents the algebraic sum of all the errors enumerated, and possibly others, the amount is not surprising, though it is larger than desirable.

[a] It has proven unexpectedly difficult to insure accurate weighing by the subjects. The record of one, who is an unusually accurate analyst in the laboratory, showed several evidences of error. To avoid this difficulty plans are being made for weighing in such way as to give an observer outside of the chamber opportunity to verify each weighing.

Estimates of amounts of oxygen consumed in the metabolism experiments.—This method of calculating the amounts of oxygen consumed has been applied to all the respiration calorimeter experiments (Nos. 5–55) with results as shown in Table 97. The table shows also the amounts of carbon dioxid eliminated and heat measured, and with them the respiratory and carbon dioxid thermal quotients.

TABLE 97.—*Respiratory and carbon dioxid thermal quotients in metabolism experiments Nos. 5–55.*

[Quantities per day.]

Kind and number of experiments.	Carbon dioxid eliminated. (a) Weight.	Carbon dioxid eliminated. (b) Volume, $a \times 0.5091$.	Oxygen consumed. (c) Weight.	Oxygen consumed. (d) Volume, $c \times 0.7$.	(e) Respiratory quotient, $b \div d$.	(f) Total heat measured.	(g) Carbon dioxid thermal quotient, $100\,a \div f$.
Rest fasting.	*Grams.*	*Liters.*	*Grams.*	*Liters*		*Calories.*	*Grams.*
Experiment No. 36	711.1	362.0	714.3	500.0	0.724	2,283	31.1
Experiment No. 39	648.9	330.4	646.0	452.2	.731	2,050	31.7
Experiment No. 42	619.7	315.5	617.8	432.5	.730	1,950	31.8
Experiment No. 51, first day	702.8	357.8	704.9	493.4	.725	2,357	29.8
Experiment No. 51, second day	698.0	355.4	700.2	490.2	.725	2,346	29.8
Average above experiments	676.1	342.2	676.6	473.6	.727	2,197	30.8
Rest, fat diet, less than 50 per cent of the energy supplied by carbohydrates.							
Experiment No. 5	849.6	432.6	708.0	495.6	.873	2,379	35.7
Experiment No. 21	797.3	406.0	681.2	476.9	.851	2,279	35.0
Experiment No. 26	719.0	366.1	603.2	422.2	.867	2,085	34.5
Experiment No. 35	812.1	413.5	689.0	482.3	.857	2,403	33.8
Average above experiments	794.5	404.5	670.6	469.4	.862	2,287	34.7
Rest, 50–60 per cent of energy supplied by carbohydrates.							
Experiment No. 8	823.5	419.3	664.1	464.9	.902	2,287	36.0
Experiment No. 9	820.0	417.5	658.1	460.7	.906	2,309	35.5
Experiment No. 13	752.3	383.0	628.5	440.0	.871	2,151	35.0
Experiment No. 14	760.0	387.0	630.2	441.1	.877	2,193	34.7
Experiment No. 23	793.8	404.2	659.7	461.8	.875	2,176	36.5
Experiment No. 25	794.4	404.5	647.5	453.3	.892	2,244	35.4
Average above experiments	790.7	402.6	648.0	453.6	.887	2,227	35.5
Rest, 73–76 per cent of energy supplied by carbohydrates.							
Experiment No. 24	846.7	431.1	656.0	459.2	.939	2,272	37.3
Experiment No. 28	772.7	393.4	600.6	420.4	.936	2,079	37.2
Average above experiments	809.7	412.3	628.3	439.8	.937	2,175	37.2
Moderate work, fat diet.							
Experiment No. 6	1,265.6	644.3	1,100.1	770.1	.837	3,726	34.0
Experiment No. 31	1,157.9	589.4	1,011.6	708.2	.833	3,420	33.9
Experiment No. 32	1,194.2	608.0	1,048.8	734.2	.828	3,565	33.5
Average above experiments	1,205.9	613.9	1,053.5	737.5	.833	3,570	33.8

TABLE 97.—*Respiratory and carbon dioxid thermal quotients in metabolism experiments Nos. 5–55*—Continued.

Kind and number of experiments.	Carbon dioxid eliminated.		Oxygen consumed.		(*e*) Respiratory quotient, $b \div d$.	(*f*) Total heat measured.	(*g*) Carbon dioxid thermal quotient, $100\ a \div f$.
	(*a*) Weight.	(*b*) Volume; $a \times 0.5091$.	(*c*) Weight.	(*d*) Volume, $c \times 0.7$.			
Moderate work, carbohydrate diet.	*Grams.*	*Liters.*	*Grams.*	*Liters.*		*Calories.*	*Grams.*
Experiment No. 11	1,366.3	695.6	1,157.0	809.9	0.859	3,921	34.8
Experiment No. 29	1,227.9	625.1	1,023.9	716.7	.872	3,589	34.2
Experiment No. 34	1,266.6	644.8	1,063.9	744.7	.866	3,587	35.3
Average above experiments	1,286.9	655.1	1,081.6	757.1	.865	3,699	34.8
Hard work, fat diet.							
Experiment No. 38	1,473.9	750.3	1,351.1	945.8	.794	4,473	32.9
Experiment No. 41	1,693.5	862.1	1,569.8	1,098.9	.785	5,237	32.3
Experiment No. 43	1,657.3	843.7	1,507.4	1,055.2	.800	5,205	31.8
Experiment No. 45	1,709.9	870.5	1,557.0	1,089.9	.799	5,162	32.1
Experiment No. 46	1,687.9	859.3	1,482.1	1,037.5	.828	5,238	32.2
Experiment No. 48	1,757.9	894.9	1,543.1	1,080.2	.829	5,218	33.7
Experiment No. 52	1,723.4	877.4	1,532.0	1,072.4	.818	5,277	32.7
Experiment No. 54	1,757.1	894.6	1,558.8	1,091.2	.820	5,215	33.7
Average above experiments	1,682.6	856.6	1,512.7	1,058.9	.809	5,128	32.8
Hard work, carbohydrate diet.							
Experiment No. 37	1,655.7	842.9	1,402.0	981.4	.859	4,760	34.8
Experiment No. 40	1,849.8	941.6	1,512.7	1,058.9	.889	5,220	35.4
Experiment No. 44	1,850.3	942.0	1,475.4	1,032.8	.912	5,199	35.6
Experiment No. 47	1,845.4	939.4	1,486.8	1,040.8	.903	5,248	35.1
Experiment No. 49	1,866.8	950.4	1,451.6	1,016.2	.935	5,245	35.9
Experiment No. 53	1,883.9	959.0	1,464.9	1,025.4	.935	5,178	36.4
Average above experiments	1,825.3	929.2	1,465.6	1,025.9	.906	5,142	35.5
5 hours' work, 1 meal, experiment No. 50	1,374.6	699.8	1,283.3	898.3	.779	4,134	33.3
Extra severe work, fat diet, experiment No. 55	3,073.6	1,564.7	2,903.4	2,032.4	.770	9,314	33.0

RESPIRATORY AND CARBON DIOXID THERMAL QUOTIENTS.

It has become customary to designate the ratio by volume of carbon dioxid exhaled to oxygen consumed as the respiratory quotient and to use this factor in studying the nature of the material oxidized in the body to produce the carbon dioxid, since it has been found that it is a very delicate index of changes going on in the body. The determinations of heat produced make it possible to calculate an analogous factor which may be called the carbon dioxid thermal quotient. A discussion of these quotients follows.

Respiratory quotient.—The method of calculating the respiratory quotient is as follows: The carbon dioxid exhaled per day in experiment No. 35, for instance, was 3,428.3 grams; the estimated weight of oxygen consumed was 2,755.9 grams. Since the weight of a liter of

carbon dioxid is 1.9642 grams and that of a liter of oxygen 1.4286 grams, the computation would be:

$$CO_2 = 3{,}248.3 \times 0.5091 = 1{,}653.7 \text{ liters.}$$
$$O_2 = 2{,}755.9 \times 0.7000 = 1{,}929.1 \text{ liters.}$$
$$\frac{CO_2}{O_2} = \frac{1{,}653.7}{1{,}929.1} = 0.857 \text{ respiratory quotient.}$$

The respiratory quotients in Table 97 above are calculated in this manner, similar experiments being grouped together and an average for each group obtained. It will be observed that the respiratory quotient is lowest in the rest experiments without food and highest in rest experiments with a diet containing the largest amount of carbohydrates. The values of the respiratory quotient in the experiments with a large amount of fat in the diet are lower than when a large quantity of carbohydrates was consumed, and they vary inversely with the amount of work performed. In two special cases (experiments Nos. 50 and 55), the first an experiment of one day with five hours' work and only one meal, and the second an experiment of one day with sixteen hours' work and three meals, the respiratory quotient is lower than in any other experiments except those of rest without food. In both these exceptional cases the food eaten supplied a large proportion of fat, but the total amounts concerned were insufficient for the work done. These variations accord closely with the composition of the food (and body materials) oxidized, as will be seen by comparing the respiratory quotients for the several compounds.

Table 98 gives the respiratory and carbon dioxid thermal quotients as calculated for some of the principal carbohydrates, fats, and protein on the assumption that their oxidation in the body occurs as stated above (page 163). The composition of starch, cane sugar, and glucose was computed in every case from the chemical formula. For the composition of animal fat average values given by Konig[a] were chosen, namely, carbon, 76.65 per cent; hydrogen, 11.92 per cent, and oxygen, 11.43 per cent. In the case of human fat the values found by Benedict and Osterberg[b] were selected, namely, carbon, 76.08; hydrogen, 11.80, and oxygen, 12.12 per cent. The figures for the oxidation of protein were estimated from its composition and that of the corresponding unoxidized material excreted in the urine. The elementary composition of the protein was assumed to be, nitrogen 16.00, carbon 53, oxygen 23, and sulphur 1 per cent, while that of the corresponding unoxidized material of the urine was taken as nitrogen 16, carbon 11.53, hydrogen 3.20, and oxygen 17.52, the amount of sulphur being unknown. The figures for urine were taken from the analyses of 145 days' urine, experiments Nos. 5–55, as shown in Table 115 of the Appen-

[a] Chemie der Menschliche Nahrungs- und Genussmittel, 3d edition, vol. 1, p. 198.
[b] Amer. Jour. Physiol., 4 (1900), p. 74.

dix. Comparing the elementary composition of the protein and that of the unoxidized portion of the urine would leave in the oxidized portion of protein no nitrogen, and carbon 41.41, hydrogen 7.80, and oxygen 5.48 per cent, it being impossible to estimate the amount of sulphur. Such calculation is based on the assumption that the unoxidized compounds in the urine are cleavage residues of protein. The figures for the heats of combustion in the table are quoted from data previously published by Atwater and Bryant.[a]

TABLE 98.—*Respiratory and carbon dioxid thermal quotients for protein, fats, and carbohydrates.*

Materials.	Oxygen required to oxidize 1 gram.		Products of the oxidation of 1 gram.				Respiratory quotient. $\frac{CO_2 \text{ cc.}}{O_2 \text{ cc.}}$	Thermal quotient, grams of carbon dioxid per 100 calories of heat.
			Carbon dioxid.					
	Weight.	Volume.	Weight.	Volume.	Water.	Heat.		
	Grams.	*Ccms.*	*Grams.*	*Ccms.*	*Grams.*	*Calories.*		*Grams.*
Starch	1.185	829.5	1.629	829.3	0.556	4.20	1.000	38.8
Cane sugar	1.122	785.4	1.543	785.5	.579	3.96	1.000	39.0
Glucose	1.066	746.2	1.466	746.2	.600	3.75	1.000	39.1
Animal fat	2.876	2,013.2	2.811	1,431.1	1.065	9.50	.711	29.6
Human fat	2.844	1,990.8	2.790	1,420.4	1.055	9.54	.713	29.2
Protein	1.367	956.9	1.520	773.8	.340	4.40	.809	34.5

The calculation of the quotients in the above table is based on three assumptions, namely, (1) the digestible carbohydrates and fats of the food not stored in the body are completely oxidized to carbon dioxid and water; (2) the body fats and carbohydrates which are katabolized also undergo complete oxidation, and (3) the katabolism of protein, be it digestible food protein not stored or body protein broken down, is such that the carbon and hydrogen not excreted in urinary compounds are oxidized to carbon dioxid and water. The respiratory quotients are: For carbohydrates, 1.000; for fats in general, 0.710, approximately (beef fat, 0.711, and human fat, 0.713); and for protein, 0.810. It is evident that an excess of carbohydrates in the diet would tend to increase the respiratory quotient over that of an ordinary diet; an excess of protein would lower it to some extent; an excess of fat would lower it still further; while in a fasting experiment, where body fat is almost the sole substance consumed, the respiratory quotient would have its lowest value. The respiratory quotients of Table 97 accord with this principle. The rest experiments without food show the lowest quotient. Those with hard work and insufficient diet and involving oxidation of considerable body fat are a little higher, and those in which carbohydrates formed the major portion of the diet give the highest of all.

[a] Connecticut (Storrs) Station Rpt. 1899, p. 73.

As a matter of fact, estimated respiratory quotients have relatively little value, because unless amounts of oxygen are determined the estimates are of such doubtful accuracy that the respiratory quotients can not be accepted as giving any certain indications of the nature of the materials oxidized. We have, however, in the comparison of carbon dioxid and heat a factor which may be used for the same purpose as the respiratory quotient.

Carbon dioxid thermal quotient.—In comparing the results of these experiments it was found that the amounts of carbon dioxid and heat produced varied so uniformly that it was believed the ratio of one to the other would afford means of judging of changes which occur in the body. This ratio, which we have called a carbon dioxid thermal quotient, is nearly uniform in experiments with the same conditions of food and work, but changes notably with changes in diet, which accords with the fact that in the oxidation of the various nutrients of food and the corresponding compounds in the body the ratio of carbon dioxid to heat is nearly uniform for different compounds of the same class and that the values are sufficiently distinctive to characterize the class.

From the composition and heats of combustion of the different classes of nutrients the ratios of carbon dioxid to heat produced by oxidation are easily computed. Provided the amount of oxygen were measured, similar ratios could be computed for carbon and heat and oxygen and heat, and would doubtless give useful data. Such ratios might be designated carbon thermal quotient and oxygen thermal quotient.

The method of computation here used is tentative and may be altered or discarded when more information accumulates. It consists simply in computing the grams of carbon dioxid exhaled or eliminated and noting the number of calories for 100 grams of carbon dioxid. In Table 98 above such calculations are made by use of the figures for heat eliminated per day. These amounts of heat correspond so closely to the quantities actually produced in the body that they may be treated as equivalent. In the work experiments the figures include the heat equivalent of the external muscular work. It is evident that the carbon dioxid thermal quotient is raised or lowered by the same conditions as those that affect the respiratory quotient, being lowest, however, in the case of the rest experiments without food.

As shown by these calculations the carbon dioxid thermal quotients for all the carbohydrates are close to 39, that for protein is about 34.5, and that for fats approximately 29.5. Accordingly an excess of carbohydrates in the diet would raise the carbon dioxid thermal quotient and an excess of fats would lower it, the limits being 29 and 39. This is actually the case in the metabolism experiments as shown by the figures reported (page 158). The carbon dioxid thermal quotient is

highest in the work experiments with large amounts of carbohydrates in the diet, is lower in the work experiments with fat diet, and lowest in the fasting experiments where the oxidation of body fat was predominant. Furthermore, it is affected by the conditions which regulate the respiratory quotient, both being raised and lowered in the same way.

An instructive use of carbon dioxid thermal quotients may be made in some of the experiments with J. C. W. to throw light upon the question as to the kinds of material oxidized in the body in different periods of the day. The calculations in these experiments are facilitated by the fact that the actual heat production in the different periods has been found by applying corrections to the figures for heat elimination as explained on pages 154–157. The carbon dioxid thermal quotients for the experiments in which these corrections were made are shown in detail in column (*g*), Table 95, and summarized for six and twelve hour periods in Table 99.

TABLE 99.—*Average carbon dioxid thermal quotients in metabolism experiments with J. C. W.*

Experiment No.	Duration.	Conditions.	6-hour periods.				12-hour periods.		24 hours.
			7 a. m. to 1 p. m.	1 p. m. to 7 p. m.	7 p. m. to 1 a. m.	1 a. m. to 7 a. m.	7 a. m. to 7 p. m.	7 p. m. to 7 a. m.	7 a. m. to 7 a. m.
	Days.		*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
35	4	Rest with food	33.0	33.9	35.3	33.0	33.4	34.3	33.8
37	4	Work, carbohydrate diet	35.7	34.5	35.2	31.8	35.1	33.8	34.8
40	4	Work, carbohydrate diet	36.1	35.2	36.5	31.9	35.7	34.6	35.4
		Average for experiments Nos. 37 and 40	35.9	34.9	35.8	31.8	35.4	34.2	35.1
38	4	Work, fat diet	33.4	33.3	31.9	31.4	33.4	31.7	32.9
41	4	Work, fat diet	32.8	32.8	30.7	30.6	32.8	30.7	32.3
		Average for experiments Nos. 38 and 41	33.1	33.1	31.3	31.0	33.1	31.2	32.6
50	1	Transition from work with fat diet to rest fasting	34.7	32.3	32.3	30.9	33.9	31.7	33.3
51	2	Rest fasting	29.2	30.4	28.7	31.3	29.8	29.9	29.8
36	1	Rest fasting	31.1	30.6	34.3	28.8	30.9	31.5	31.1
39	1	Rest fasting	31.6	32.0	33.4	29.6	31.8	31.5	31.7
42	1	Rest fasting	35.1	31.7	31.1	29.1	33.2	30.1	31.8
		Average for experiments Nos. 36, 39, and 42	32.5	31.4	32.9	29.1	31.9	31.0	31.5

Comparing the carbon dioxid thermal quotients for the 12-hour periods in the experiments in which the subject had an abundant diet it will be noticed that they are in nearly every individual case lower, and in the average of both rest and work experiments they are decidedly lower for the night than for the day period. In like manner the quotients for the second half of the night period—i. e., the 6-hour periods

from 1 a. m. to 7 a. m. are smaller than those of the previous 6-hour period in every experiment except No. 51, in which the subject fasted for two days after a day of partial fasting.

Remembering that the lower quotient corresponds to an oxidation of fats and the higher to an oxidation of carbohydrates, these differences may be interpreted as indicating that carbohydrates are oxidized more speedily than fats, and that the oxidation of the carbohydrates of the food for the day has pretty nearly ceased by midnight. The very low quotients which are found so regularly for the second night period favor this interpretation. The hypotheses that the carbohydrates are oxidized more speedily than the fats and that, after a meal, the oxidation of carbohydrates predominates at first and later that the oxidation of fats is most prominent, is supported by the figures of experiments Nos. 50 and 51. During the former, which covered one day of partial fasting, the subject worked during the forenoon and rested during the remainder of the day. The day was therefore one of transition from work with food to rest with fasting. The quotient fell from the first day period of 6 hours to the second night period, where it was only 30.9. This accords with the hypothesis that there was considerable oxidation of carbohydrates in the forenoon, but that the material burned at night was mostly fat.

In the two consecutive fasting days (experiment No. 51), which immediately followed, the carbon dioxid thermal quotient was found to be exceptionally low, and is almost identical for each of the two days. Since in this experiment it lies so close to 29 for all periods, it would seem to point conclusively to the fact that very little was oxidized except body fat, and that whatever glycogen was lost by the body during the period of fasting was oxidized during experiment No. 50.

In experiments Nos. 35, 37, 38, 40, and 41 with food, and in experiment No. 50 which covered the transition period from food to fasting, the carbon dioxid thermal quotients favor the hypothesis that the carbohydrates were burned mostly during the day and evening and fats supplied the bulk of the fuel at night. The figures, however, permit another interpretation, namely, that during the night there is a considerable oxidation of fat into glycogen and that the latter is oxidized into carbon dioxid and water during the day. The oxidation of fat to glycogen involves oxygen consumption and heat production without the production of carbon dioxid, and hence the corresponding respiratory and carbon dioxid thermal quotients would be zero. Since the observed quotients correspond to the total production of carbon dioxid and heat in the body and the oxidation of fat to glycogen would yield heat without carbon dioxid, the effect of this glycogenesis would be to reduce the quotient. To state the principle in another way, the lowering of the quotient might be ascribed to either the oxidation of fat in place of carbohydrates or to the production of glycogen from fat. (See also below.)

Need of determination of all the factors of income and outgo of both matter and energy.—It is thus clear that neither the respiratory quotient nor the carbon dioxid thermal quotient suffices to show exactly what materials are actually oxidized in the body.[a] The data of the experiments are not sufficient, since the determinations of the oxygen balance are lacking. If the oxygen of income and outgo had been accurately determined it would have been possible to calculate the gains and losses of protein, fats, carbohydrates, water, and energy. It is with this in view that arrangements for the direct determination of oxygen have been lately added to the respiration calorimeter and it is hoped that a number of experiments may soon be made in which the complete balance of income and outgo of matter and energy will be shown.

CARBOHYDRATES (GLYCOGEN) IN THE BODY.

In calculating the balance of income and outgo of matter and energy in experiments with the respiration calorimeter in this laboratory we have followed the common practice of assuming that the amount of carbohydrates (glycogen) in the body is the same at the beginning and at the end of the experiments; also at the beginning and end of the experimental days. In other words, it is assumed that whatever the fluctuations of the glycogen (carbohydrate) content of the body during the twenty-four hours a constant glycogen level will be reached at 7 a. m., after the night's rest and at the end of the longest interval between meals. This assumption of uniform carbohydrate level is not established experimentally, but inasmuch as the diet, bodily activity, and other conditions of most of the experiments were the same from day to day, and since in general there was no great storage or loss of body material, it seemed advisable to follow the usual practice until more complete data shall be available. In experiments where the diet was markedly insufficient, as in Nos. 50 and 55, or in others where no food was given, it is reasonable to expect that the glycogen in the body as well as the protein and fat would be drawn upon to make up the deficiency. We hope that in future experiments when the consumption of oxygen is directly determined we shall have data for estimating the gains or losses of glycogen, or at least that some light will be thrown upon this important question, but with the present state of our knowledge we do not feel justified in drawing any hard and fast conclusion regarding it.

AMOUNTS OF ENERGY DERIVED FROM DIFFERENT NUTRIENTS.

The tendency in discussing the needs of the body for different nutrients is decidedly toward the reckoning of transformations of

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[a] Berthelot, Chaleur Animale, 1899, p. 127 et seq.

matter and energy in terms of energy. This is manifest in the expression of dietary standards in terms of protein and energy rather than protein, fats, and carbohydrates. The principle seems to be intrinsically valid and practically useful. It will, therefore, be interesting for some of the discussions which follow to note the amounts and proportions of energy which are supplied by the different ingredients of the food and body material in the experiments here discussed and compare them with the total amounts of energy later. Such a comparison for the experiments of J. C. W. is given in Table 126 of the Appendix and summarized in Table 100 herewith. With this brief statement the data in these tables will be utilized in the discussions of succeeding topics.

TABLE 100.—*Income and outgo of energy, showing sources of same.*

Conditions of experiment.	Energy calculated.				Energy measured.		
	From protein.	From fats.	From carbohydrates.	Total.	As heat.	As muscular work.	Total.
Rest experiments with and without food.							
	Calories.	*Calories.*	*Calories.*	*Calories.*	*Calories.*	*Calories.*	*Calories.*
Average for 4 experiments without food, 5 days	358	1,892	0	2,250	2,187	0	2,187
One experiment with food, 4 days	429	814	1,114	2,357	2,397	0	2,397
Work experiments.							
CARBOHYDRATE DIET.							
Average for 4 experiments, 16 days	438	1,474	3,181	5,093	4,569	539	5,108
Average for 2 experiments, 6 days	425	795	3,876	5,096	4,660	551	5,211
Average for 6 experiments, 22 days	434	1,288	3,371	5,093	4,593	543	5,136
FAT DIET.							
Average for 4 experiments, 16 days	507	3,191	1,359	5,056	4,512	529	5,041
Average for 2 experiments, 6 days	442	3,161	1,729	5,332	4,645	601	5,246
Average for 6 experiments, 22 days	489	3,190	1,465	5,144	4,555	550	5,105
Experiment with 16 hours' work	478	7,744	1,759	9,981	7,832	1,482	9,314

Regarding the figures of the above table several points are to be noted. The gains and losses of body material are computed on the basis of gains and losses of nitrogen and carbon and it is assumed that the carbon gained or lost other than that of protein belongs wholly to body fat. This assumes that there is no change in the amounts of carbohydrates in the body during the period in question. Of course this last assumption is gratuitous and in many cases is doubtless wrong. In the fasting experiments, especially, it is highly probable that the body would lose more or less of its store of carbohydrates along with the stored protein and fat consumed to supply its

needs. The same remark would apply to the experiments with food in which the quantity of the latter was insufficient to supply the bodily demand. On the other hand, in the cases where the body gained carbon, it may be that part of this excess was stored as carbohydrate. Here again the computations in the tables would be incorrect. If we were certain that the figures for energy measured were absolute, and if we could further assume that the quantities of material in the alimentary canal at the beginning and end of a given experiment or experimental period were the same, we might use the energy of outgo for calculating the amounts of carbohydrates as well as fats gained or lost. The results would be still more satisfactory if we had an exact comparison of the income and outgo of oxygen.

FATS VERSUS CARBOHYDRATES AS PROTECTORS OF BODY MATERIAL.

Four of the later series of experiments were especially planned for the study of the comparative efficiency of fats and carbohydrates, both as regards the protection of body material and as fuel for the production of muscular work. These experiments were all made upon the same subject (J. C. W.), who in each of the cases here considered was engaged in active muscular work for 8 hours per day. There are four pairs of experiments which best permit a direct comparison of fat with carbohydrates, namely, Nos. 40 and 41, 43 and 44, 46 and 47, and 52 and 53.

Some of the earlier experiments with other subjects, while not planned with reference to this particular question may still throw some light upon it, and four pairs of these experiments are also considered here, viz: Rest experiments with J. F. S., Nos. 25 and 26; work experiments with J. F. S., Nos. 29 and 32; rest experiments with E. O., Nos. 5 and 9, and work experiments with E. O., Nos. 6 and 11. These are less strictly comparable than those with J. C. W. for the reason stated beyond. The data for the comparison of fats and carbohydrates as protectors of body material are therefore drawn from four directly comparable pairs of experiments aggregating 30 experimental days and four less directly comparable pairs aggregating 28 days, making a total of 58 experimental days and including work experiments with three, and rest experiments with two different men. In order to simplify the tabulation and discussion of the results it seems desirable to consider the protection of protein and protection of body fat separately.

Fats versus carbohydrates as protectors of protein.—In Table 101 the results of the eight pairs of experiments mentioned above are tabulated with reference to the comparative efficiency of fats and carbohydrates as protectors of protein.

TABLE 101.—*Fats versus carbohydrates as protectors of protein.*

Subject and kind of experiment.	Duration.	Available energy of food.	Energy of external muscular work.	Nitrogen. In food.	Nitrogen. In feces.	Nitrogen. In urine.	Nitrogen. Gain (+) or loss (−).
Directly comparable experiments.	*Days.*	*Calories.*	*Calories.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
Experiment No. 40, work; subject, J. C. W., carbohydrate diet	4	4,180	518	17.1	2.2	17.1	−2.2
Experiment No. 41, work; subject, J. C. W., fat diet	4	4,150	522	16.9	1.5	20.3	−4.9
Experiment No. 44, work; subject, J. C. W., carbohydrate diet	4	4,602	571	17.8	2.6	17.3	−2.1
Experiment No. 43, work; subject, J. C. W., fat diet	4	4,496	548	17.1	2.0	19.1	−4.0
Experiment No. 47, work; subject, J. C. W., carbohydrate diet	4	4,366	562	17.4	2.7	16.3	−1.6
Experiment No. 46, work; subject, J. C. W., fat diet	4	4,478	551	17.0	1.8	16.1	− .9
Experiment No. 53, work; subject, J. C. W., carbohydrate diet	3	5,132	587	17.9	2.3	15.4	+ .2
Experiment No. 52, work; subject, J. C. W., fat diet	3	5,120	607	17.7	1.6	16.4	− .3
Average, 4 work experiments; subject, J. C. W., carbohydrate diet	15	4,532	558	17.5	2.5	16.6	−1.5
Average, 4 work experiments; subject, J. C. W., fat diet	15	4,524	554	17.1	1.7	18.1	−2.7
Less directly comparable experiments.							
Experiment No. 29, work; subject, J. F. S., carbohydrate diet	3	3,260	255	16.0	.8	16.0	− .8
Experiment No. 32, work; subject, J. F. S., fat diet	3	3,226	196	16.1	1.2	15.7	− .8
Experiment No. 25, rest; subject, J. F. S., carbohydrate diet	3	2,638	....	17.7	1.0	16.4	+ .3
Experiment No. 26, rest; subject, J. F. S., fat diet	3	2,256	....	15.9	1.1	15.3	− .5
Experiment No. 11, work; subject, E. O., carbohydrate diet	4	3,510	187	19.8	2.2	18.1	− .5
Experiment No. 6, work; subject, E. O., fat diet	4	3,414	256	19.1	1.5	16.5	+1.1
Experiment No. 9, rest; subject, E. O., carbohydrate diet	4	2,426	....	19.1	1.3	18.4	− .6
Experiment No. 5, rest; subject, E. O., fat diet	4	2,384	....	19.1	1.7	18.1	− .7
Average, 4 experiments, rest and work, 2 subjects, carbohydrate diet	14	2,960	....	18.3	1.4	17.4	− .5
Average, 4 experiments, rest and work, 2 subjects, fat diet	14	2,831	....	17.8	1.4	16.5	− .1
All above experiments.							
Average, 8 experiments, rest and work, 3 subjects, carbohydrate diet	29	3,773	....	17.9	1.9	17.0	−1.0
Average, 8 experiments, rest and work, 3 subjects, fat diet	29	3,707	....	17.4	1.6	17.3	−1.5

In order to ascertain the efficiency of fats and carbohydrates as protectors of protein, it is necessary to compare the quantities of nitrogen in the digestible food with the amounts found in the urine, as this affords a means of studying the metabolism of protein in the body. Such data are shown in Table 101. In the directly comparable experiments included in the table—namely, those with J. C. W.—the nitro-

gen of the urine was in one case practically the same with both the fat and carbohydrate diets, while in the other three cases there was a slightly larger amount of nitrogen in the urine in experiments with the fat diet, which was also the case when the average of all these experiments is considered.

In the less comparable experiments the differences in two cases are negligible, while in two other cases the amount of nitrogen in the urine was smaller in the experiments with fat diets. In one of these cases, however, the length of time between the two experiments compared—namely, Nos. 6 and 11—was so long that the bodily conditions of the subject may have changed materially. The other pair compared—namely, experiments Nos. 25 and 26—were in the same consecutive series and were of the same general plan as the more directly comparable experiments, but were not so satisfactory in all ways as the later ones.

In all of the strictly comparable experiments—i. e., in each of the four pairs of experiments with J. C. W.—there was a larger elimination of nitrogen in the feces from the diet rich in carbohydrates than from that in which the fats preponderated.

The increase in fecal nitrogen on the carbohydrate diet is too great and too uniform to be regarded as entirely accidental, and must be due to the difference in the diets. This does not, however, necessarily imply that the abundance of carbohydrates present decreased the digestibility of the protein of the food. Such an explanation would be necessary if the extra carbohydrate or extra fat had been simply added to an otherwise uniform diet. In most cases, however, this was impracticable, and it was found necessary to increase the carbohydrates partly by the addition of cereals, and the fat partly by the addition of milk or cream; and so the carbohydrate diet contained in most cases more vegetable and less animal protein than the fat diet. Thus in the case of the four pairs of experiments with J. C. W., approximately two-thirds of the protein in the sugar diet and only one-third in the fat diet was of vegetable origin.

Assuming the average amount of protein ($N \times 6.25$) in the feces to be 3 per cent of the total protein in the animal food and 15 per cent of the total in the vegetable food, a supposition which may or may not be wholly correct in these particular experiments, but which represents the average values deduced from a study of a large number of American and European experiments previously summarized,[a] the amount of nitrogen of feces in the experiments in which two-thirds of the protein was of vegetable origin would probably be one-half larger than the amount in the feces from a diet with the same energy and protein values, but with only one-third of the protein derived from vegetable sources. In the experiments with J. C. W. the actual

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[a] Connecticut (Storrs) Station Rpt. 1899, p. 86.

amounts of nitrogen eliminated by the feces are somewhat larger than the values which would be calculated by the coefficients of digestibility which we are accustomed to use (see page 112); but the average amounts eliminated on the two diets are in practically exact proportion to the quantities estimated from the proportions of animal and vegetable protein consumed.

It thus seems probable that the larger amount of fecal nitrogen found in the carbohydrate periods is due not to an increased amount of carbohydrates in the diet, but to the increased proportion of vegetable protein. It should also be noted that in many instances in these experiments a considerable part of the extra vegetable protein was added in graham crackers, in which form it has been found to be even less digestible than that in such materials as white bread.

In the earlier and less directly comparable experiments where the proportion of animal to vegetable protein was kept practically constant no more fecal nitrogen was found on one diet than on the other.

Considering the nitrogen of the food minus that of the feces as representing what is actually available for the uses of the body, we find that in the average of the directly comparable experiments there was slightly less digestible nitrogen in the carbohydrate diet than in the fat diet. Nevertheless, less nitrogen was excreted in the urine, i. e., there was a smaller loss of body nitrogen with the carbohydrate than with the fat diet. The total available energy and the muscular work were practically uniform in this group of experiments; therefore it would appear that for the protection of protein the carbohydrates, largely sugar, were slightly more efficient than isodynamic amounts of fat.

On the other hand, in the less directly comparable series which includes experiments with two different subjects, at work and at rest, we find no appreciable difference in the economy of utilization of the protein of the fat and carbohydrate diets. Comparing the averages of all the experiments, the apparent advantage of the carbohydrates over the fat as a protector of protein appears to be represented by a saving of only about 3 grams of protein per day, as shown by the amounts excreted in the urine, which might easily be considered negligible or as due simply to the fact that the carbohydrate diet furnished a slightly higher average fuel value.

It should be noted, however, that this average includes the results of some pairs of experiments which were separated by several months during which time the bodily condition of the subject, the demands of the body for food, and its tendency to store or waste the protein supplied to it may have undergone sufficient change to largely vitiate the comparison. The experiments with J. C. W. are not only more directly comparable, but they are also better calculated to bring out any difference which might exist, inasmuch as the amounts of fat and carbohydrates consumed were greater than in any of the earlier experiments. When only the more directly comparable experiments are

considered the advantage of the carbohydrates over the fat, although small, is distinctly apparent in the average figures.

As has been pointed out in considering the elimination of nitrogen by the feces, the protein of the carbohydrate diet was mainly of vegetable origin, while that of the fat diet was mainly in the form of animal foods, and especially of milk and cream. Considering that the proportion of nonproteid nitrogen is somewhat larger in cereal products than in milk, it is probable that if the amounts of digestible nitrogen in the two diets were equal, the amount of true proteid matter would be slightly larger in the fat diet. If such were the case the difference in favor of the efficiency of the sugar must have been actually somewhat larger than the figures in the table would indicate.

The results thus far obtained in these experiments point toward a slight superiority of carbohydrates over fats as protectors of protein. This may, however, depend to some extent upon the individual subject, and repeated experiments with a larger number of subjects will be required to settle this question of the superiority and show its amount.

In the above experiments fairly large amounts of protein were consumed. Some experiments with men have been recently published by E. Landergren[a] in which the power of fats or carbohydrates to protect protein was studied. In general, the diets supplied only a limited amount of nitrogen with an abundance of carbohydrates, or fat, or both, while in one case the subjects fasted. Under the experimental conditions the body reached a condition after a few days where apparently not more than 3 or 4 grams of nitrogen was metabolized per day providing a minimum quantity of carbohydrates was present, the amount not being definitely known. Landergren believed that his results showed that in general fat protected protein as well as an isodynamic quantity of carbohydrates, both in a condition of nitrogen hunger and nitrogen abundance, but it was noted that under certain conditions fat exhibited less than one-half of this protective power when carbohydrates were absent. This is explained on the ground that when carbohydrates are no longer supplied some must be formed in the body from protein, and that fat can not serve for this purpose in the place of protein. In other words, as soon as the glycogen of the body is exhausted fat is inferior to carbohydrates as a protector of protein.

Many additional investigations which bear on this subject have been reported which should be taken into account before the question can be adequately discussed.

Fats versus carbohydrates as protectors of body fat.—The results of the experiments discussed in the preceding section which bear directly upon the protection of body fat are brought together in Table 102.

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[a] Skand. Arch. Physiol., **14** (1903), p. 112.

TABLE 102.—*Fats versus carbohydrates as protectors of body fat.*

Subject and kind of experiment.	Duration.	Available in food.		Energy of external muscular work.	Energy of material oxidized.	Gain (+) or loss (−) in body material.			
		Protein.	Energy.			Protein.	Energy of protein.	Fat.	Energy of fat.
Directly comparable experiments.									
	Days.	*Gms.*	*Cals.*	*Cals.*	*Cals.*	*Gms.*	*Cals.*	*Gms.*	*Cals.*
Experiment No. 40. work; J. C. W., carbohydrate diet	4	17.1	4,180	518	5,251	−13.6	− 77	−104.2	−994
Experiment No. 41, work; J. C. W., fat diet	4	16.9	4,150	522	5,304	−30.6	−173	−102.8	−981
Experiment No. 44, work; J. C. W., carbohydrate diet	4	17.8	4,602	571	5,125	−13.1	− 74	− 47.1	−449
Experiment No. 43, work; J. C. W., fat diet	4	17.1	4,496	548	5,155	−25.0	−141	− 54.3	−518
Experiment No. 47, work; J. C. W., carbohydrate diet	4	17.4	4,366	562	5,173	−10.1	− 58	− 78.5	−749
Experiment No. 46, work; J. C. W., fat diet	4	17.0	4,478	551	5,193	− 5.6	− 32	− 71.6	−683
Experiment No. 53, work; J. C. W., carbohydrate diet	3	17.9	5,132	587	5,104	+ 1.3	+ 8	+ 2.1	+ 20
Experiment No. 52, work; J. C. W., fat diet	3	17.7	5,120	607	5,309	− 2.1	− 12	− 18.6	−177
Average, 4 work experiments, J. C. W., carbohydrate diet	15	17.5	4,532	558	5,167	− 9.5	− 54	− 60.9	−581
Average, 4 work experiments, J. C. W., fat diet	15	17.1	4,524	554	5,236	−16.7	− 95	− 64.7	−617
Less directly comparable experiments.									
Experiment No. 29, work; J. F. S., carbohydrate diet	3	16.0	3,260	255	3,517	− 5.0	− 28	− 23.9	−229
Experiment No. 32, work; J. F. S., fat diet	3	16.1	3,226	196	3,590	− 5.0	− 28	− 35.1	−336
Experiment No. 25, rest; J. F. S., carbohydrate diet	3	17.7	2,638	......	2,241	+ 1.9	+ 11	+ 40.5	+386
Experiment No. 26, rest; J. F. S., fat diet	3	15.9	2,256	......	2,043	− 3.3	− 19	+ 24.3	+232
Experiment No. 11, work; E. O., carbohydrate diet	4	19.8	3,510	187	3,909	− 3.0	− 17	− 40.1	−382
Experiment No. 6, work; E. O., fat diet	4	19.1	3,414	256	3,839	+ 6.9	+ 39	− 48.7	−464
Experiment No. 9, rest; E. O., carbohydrate diet	4	19.1	2,426	......	2,272	− 3.6	− 20	+ 18.3	+174
Experiment No. 5, rest; E. O., fat diet	4	19.1	2,384	......	2,482	− 4.2	− 24	− 7.8	− 74
Average, 4 experiments, rest and work, 2 subjects, carbohydrate diet	14	18.3	2,960	......	3,000	− 2.5	− 14	− 2.7	− 26
Average, 4 experiments, rest and work, 2 subjects, fat diet	14	17.8	2,831	......	3,013	− 1.0	− 6	− 18.5	−176
All above experiments.									
Average, 8 experiments, rest and work, 3 subjects, carbohydrate diet	29	17.9	3,773	......	4,121	− 6.2	− 35	− 32.8	−313
Average, 8 experiments, rest and work, 3 subjects, fat diet	29	17.4	3,707	......	4,163	− 9.4	− 52	− 42.4	−404

In some cases there appears to be a slightly better utilization or storage of body fat with the carbohydrate diet and in other cases with the fat diet. In the experiments with J. C. W. the average loss of body fat was slightly less on the carbohydrate than on the fat diet. Since the fuel value of the diet and the amounts of muscular work performed were practically the same in both cases, the figures indicate

that the sugar was a slightly better protector of body fat than the fat in this group of experiments, in all of which a considerable amount of muscular work was performed. The difference, however, is very small, averaging only 3.8 grams of fat, equivalent to about 36 calories per day, or less than one per cent of the total energy metabolized.

In the less directly comparable experiments the diet and muscular work were not so uniform as in those with J. C. W. If, however, the average results of the four pairs of experiments be taken together, it appears that the body lost more fat on the fat diet than on the carbohydrate diet, the extra fat thus lost being equivalent to 150 calories per day. The fuel value of the carbohydrate diet exceeds that of the fat diet by very nearly this amount. But it is to be noted that slightly more work was performed on the fat than on the sugar diet. If, therefore, the fat diet is credited with the extra work done it would seem that the fat was slightly better utilized than the carbohydrate.

The differences in utilization of the energy of the two diets are thus seen to be extremely small and not always in the same direction. On the whole, therefore, it can not be said that these experiments show any appreciable difference between fats and carbohydrates as protectors of body fat.

In most of the experiments here reported a considerable amount of work was performed, usually enough to necessitate the consumption of more or less body material in addition to the materials supplied by the food. The question of fats versus carbohydrates as protectors of body fat becomes, therefore, inseparable from the question of the relative efficiency of fats and carbohydrates as sources of energy for muscular work.

FATS VERSUS CARBOHYDRATES AS SOURCES OF ENERGY FOR MUSCULAR WORK.

As yet there is no method of so tracing the transformations of either protein, fat, or carbohydrates in the body as to separate the kinetic energy which comes from any one of these nutrients from that which is supplied by the others and of determining how the energy from each is disposed of, nor is there any definite evidence that the body itself utilizes differently the kinetic energy arising from the oxidation of the different nutrients. It would rather seem to be a case of "pooling" in which the energy of the material katabolized is utilized as a whole for the needs of the body, whatever they may be.

Experiments of the kinds here reported may, therefore, compare the economy of utilization of the total energy thus "pooled" (1) when the greater part is supplied by carbohydrates and (2) when the greater part is supplied by fats. They may thus afford a more or less clear indication of the relative efficiency of fats and carbohydrates as fuel for muscular work. The total quantities of the several ingredients of food and body material oxidized and the potential energy of each are

determined in the experiments with the respiration calorimeter, as is the total amount of external muscular work performed. Of the internal muscular work there is no certain measure, but it is known to be considerable. It is also well established that in the performance of external muscular work the total energy transformed is several times as much as the energy of the muscular work itself. It is natural to presume that the same may be true of internal muscular work, though this is not absolutely proven. At any rate, the energy which is converted into internal and external muscular work must be greater than the energy of the external work alone. Further, when the food supplied is not quite sufficient to furnish the necessary energy and the body is obliged to supplement the supply of energy by drawing upon its own store of material, it is reasonably safe to assume that the energy of each and all of the materials burned will be utilized as economically as their character permits.

If, now, two experiments are compared in which the diet is insufficient to meet the demands of the body and which are alike or nearly alike in the amounts of total digestible protein and total available energy furnished and total external muscular work performed, but different in the proportions of carbohydrates and fats supplied, and we find that the total energy metabolized for the production of the fixed amount of work is the same with the fat diet as with the carbohydrate diet, it is reasonable to conclude that the fats and carbohydrates were of equal value as sources of muscular energy, or at any rate as parts of a ration for muscular work. If, on the other hand, with diets of like energy value, and with like work performed, the loss of body material is greater with either the carbohydrate or the fat ration, the inference is that more total energy from one ration was required than from the other, and consequently that a calorie of energy from the carbohydrate or fat, as the case may be, was of less value than a calorie from the other source. The principle is the very obvious one that the material of which the larger amount is required for a given effect is inferior in efficiency and vice versa. And it is to be constantly borne in mind that the amounts of carbohydrates and fats are not compared by weight but by potential energy. This is another way of stating the fact that in these experiments isodynamic amounts of fats and carbohydrates are compared with each other. The question accordingly is this: Of two rations, one furnishing a large proportion of carbohydrates and the other an isodynamic quantity of fat, and both inadequate to the demands of the body, will there be any difference in the total quantities of energy transformed and in the drafts which the body makes on its previously accumulated store of material to supply its demands for a like amount of energy or muscular work?

We thus have two tests of the relative efficiency of the fats and carbohydrates. One is found in the total energy transformed. If it costs more energy to do the same work with the carbohydrates than with

the fats the carbohydrates are the less and the fats the more efficient, and a fat calorie is worth more than a carbohydrate calorie in the ration, and vice versa if more potential energy becomes kinetic with the fat ration the fat is inferior and the carbohydrate superior as a source of energy.

The other test is found in the draft upon body material as measured in terms of energy. If the draft is smaller with the carbohydrate than with the fat, the carbohydrate energy is more efficient. But if the body uses less of its material with the fat ration the fat has the higher energy—efficiency value.

These two tests really represent two views of essentially the same question, which is really the one just discussed in comparing carbohydrates and fats as protectors of body material.

In the seven pairs of work experiments in which the fats and carbohydrates may be compared the data bearing upon these two points are condensed in Table 103.

TABLE 103.—*Relative efficiency of fats and carbohydrates in rations for muscular work.*

Subject and kind of experiment.	Duration.	Available energy of food.	Energy of external muscular work.	Energy of material oxidized.	Energy of body, materal gained (+) or lost (−).
Directly comparable experiments.	*Days.*	*Calories.*	*Calories.*	*Calories.*	*Calories.*
Experiment No. 40, subject J. C. W., carbohydrate diet	4	4,180	518	5,251	−1,071
Experiment No. 41, subject J. C. W., fat diet	4	4,150	522	5,304	−1,154
Experiment No. 44, subject J. C. W., carbohydrate diet	4	4,602	571	5,125	− 523
Experiment No. 43, subject J. C. W., fat diet	4	4,496	548	5,155	− 659
Experiment No. 47, subject J. C. W., carbohydrate diet	4	4,366	562	5,173	− 807
Experiment No. 46, subject J. C. W., fat diet	4	4,478	551	5,193	− 715
Experiment No. 53, subject J. C. W., carbohydrate diet	3	5,132	587	5,104	+ 28
Experiment No. 52, subject J. C. W., fat diet	3	5,120	607	5,309	− 189
Average 4 experiments, subject J. C. W., carbohydrate diet	15	4,532	558	5,167	− 635
Average 4 experiments, subject J. C. W., fat diet	15	4,524	554	5,236	− 712
Less directly comparable experiments.					
Experiment No. 29, subject J. F. S., carbohydrate diet	3	3,260	255	3,517	− 257
Experiment No. 31, subject J. F. S., fat diet	3	3,275	249	3,441	− 166
Experiment No. 34, subject J. F. S., carbohydrate diet	3	3,241	250	3,644	− 403
Experiment No. 32, subject J. F. S., fat diet	3	3,226	196	3,590	− 364
Experiment No. 11, subject E. O., carbohydrate diet	4	3,510	187	3,909	− 399
Experiment No. 6, subject E. O., fat diet	4	3,414	256	3,839	− 425
Average 3 experiments, subjects E. O. and J. F. S., carbohydrate diet	10	3,354	226	3,712	− 358
Average 3 experiments, subjects E. O. and J. F. S., fat diet	10	3,316	236	3,645	− 329
All the above experiments.					
Average 7 experiments, with 3 subjects, carbohydrate diet	25	4,061	425	4,585	− 524
Average 7 experiments, with 3 subjects, fat diet	25	4,040	427	4,599	− 559

The directly comparable experiments (those with J. C. W.) show a somewhat higher efficiency for the carbohydrate than for the fat diet. In the less directly comparable experiments the results are not concordant, but the average shows a slight apparent advantage of the fat over the carbohydrate. In the average of all the experiments the differences between the two series practically neutralize each other and there is no appreciable difference in efficiency, the slightly larger draft upon body material in the average of the fat experiments being no more than might be expected from the fact that the diet was slightly smaller and the amount of work done was a trifle larger.

The experiments with J. C. W. are perhaps much better fitted than the others to throw light upon this question, and the statistics as recorded for these appear to exhibit an appreciable advantage for the carbohydrate over the fat ration. This is made clearer by recalculating the results so as to show the relative value of the fat and carbohydrate diets in terms of calories of energy metabolized per day and in terms of the percentage efficiency of the fat as compared with the carbohydrate diet and of the fat itself as compared with the carbohydrates. The results are shown in Table 104.

TABLE 104.—*Efficiency of fats versus carbohydrates in work experiments with J. C. W.*

Experiments.	Duration of each experiment.	Apparent deficiency with the fat diet.	Percentage efficiency of energy. Energy of fat diet as compared with energy of carbohydrate diet.	Percentage efficiency of energy. Energy of fats as compared with energy of carbohydrates.
	Days.	*Calories.*	*Per cent.*	*Per cent.*
Experiment No. 40, carbohydrate diet, and experiment No. 41, fat diet; average per day	4	33	99.2	98.3
Experiment No. 44, carbohydrate diet, and experiment No. 43, fat diet; average per day	4	145	96.8	92.8
Experiment No. 47, carbohydrate diet, and experiment No. 46, fat diet; average per day	4	75	98.3	96.2
Experiment No. 53, carbohydrate diet, and experiment No. 52, fat diet; average per day	3	105	97.9	94.8
Average of the above experiments	15	89	98.0	95.5

The figures in the column "Apparent deficiency with fat diet," represent the algebraic sum of (1) the difference in the available energy of food, (2) the difference in energy of body material oxidized, and (3) five times the difference in the heat equivalent of the external muscular work, since for this subject the mechanical efficiency was found to be very close to 20 per cent, or, in other words, the 5 calories which must be metabolized for the production of an amount of external muscular work equivalent to 1 calorie. With experiments Nos. 40 and 41 the difference in the available energy of the food is 30 calories, the difference in the energy of body material oxidized is −83 calories, the work done is equivalent to 4 calories more with the fat than with the carbohy-

drate diet on account of which the fat diet is credited with 20 calories. We thus have for the fat as compared with the carbohydrate diet (+30, −83, and +20 calories) a balance of −33 calories, or, in other words, a deficit of 33 calories in the utilization of the energy with the fat as compared with the carbohydrate diet. The total available energy of the diet was 4,165 calories (mean of 4,180 and 4,150), of which the 33 calories is 0.8 per cent. Assuming the difference to be due wholly to the inferiorty of the fat diet, the effectiveness of the latter as compared with the carbohydrate diet would be 99.2 per cent. The quantities of fats and carbohydrates which replaced each other in these experiments furnished approximately 2,000 calories of energy, of which the 33 calories would represent 1.7 per cent. If, therefore, we charge the deficit wholly to the fat, the latter would be, calorie for calorie, 98.3 per cent as effective as the carbohydrates. The same method of calculation gives 88 calories as the average deficit per day for the fats, and makes the fat diet 98 per cent as efficient as the carbohydrate diet, and the fat itself 95.5 per cent as efficient as the carbohydrate.

It is to be borne in mind in this discussion that one of the values referred to above, namely, the heat equivalent of external muscular work, could not in these experiments be determined as accurately as desired, because of imperfections in the ergometer used, as previously pointed out (see pages 30–34). The calibrations of this apparatus indicated the possibility of variations of several per cent either side of the mean. It is highly probable that these errors tended to counterbalance, so that the general average would be not far from the truth; the present discussion is based on the assumption that such was the case. On the other hand, it may be that such errors affected the experiments with one ration more than those with the other, and in view of such a possibility a considerable degree of reserve is called for in accepting the figures for external muscular work, especially since whatever error there is here is multiplied by 5, as explained above. With this reservation the present discussion seems warranted. And since the differences, while not large, seem constant in one direction, so far as the data may be accepted they suggest that with J. C. W. the energy of the carbohydrates was utilized more efficiently for the production of muscular work than that of the fats.

In the four pairs of experiments with J. C. W., the results of which are tabulated on page 185 and furnish the basis for the above discussion, it is to be noted that in one case (Nos. 40 and 41) the carbohydrate diet preceded the fat diet, while in the other three cases the fat preceded the carbohydrate diet. In spite of this difference in the order of arrangement, the slight apparent superiority of the carbohydrate over the fat ration is noticeable in all four cases. Moreover, in each of the three cases in which the experiment with fat diet preceded that with carbohydrate diet, the latter was followed by an experiment of a single day with the fat diet. These experiments (Nos. 45, 48, and 54—see Table 69, page 101) may be compared with the carbohydrate diet which

they followed, and the effectiveness of the energy of the fat versus the carbohydrate ration computed in the manner already described in detail (page 183), though the experiments are of course less valuable than the others, inasmuch as the duration of the fat experiment was in each case only one day. However, it is interesting to note that in every case such a comparison shows an apparent superiority of the carbohydrate over the fat diet. Thus, a consideration both of the order of sequence of the three and four day experiments which are tabulated and discussed in detail, and of the single-day experiments just mentioned, confirms the conclusion that, if the data are trustworthy, for J. C. W. the carbohydrates were somewhat superior to the fat as part of a diet for muscular work, regardless of the sequence of the experiments.

On the other hand, if we should average the experiments with J. C. W. with the less directly comparable pairs of experiments with J. F. S. and E. O. (see Table 103, above) the totals would show no appreciable difference in the apparent effectiveness of the carbohydrate and fat diets. It is possible that the lower efficiency of the fat with J. C. W. may be due to the individuality of the subject rather than to any real and inherent inferiority of the fat as compared with the carbohydrate.

The general conclusion is that in these experiments the fats were slightly inferior to isodynamic amounts of carbohydrates as parts of a ration for muscular work. But while the natural inference is that calorie for calorie the carbohydrates were slightly superior to the fats as sources of muscular energy, the difference observed was very small and may have been due to some individual peculiarity of the subject with which the more directly comparable experiments were made rather than to any inherent difference in the capacity of the materials to yield energy for external muscular work.

CARBOHYDRATES AND FATS VERSUS PROTEIN AS SOURCES OF ENERGY FOR MUSCULAR WORK.

It is generally believed by physiologists to-day that while the energy of protein may be and actually is used for muscular activity carbohydrates and fats are the chief sources of muscular energy. Liebig's theory has, however, been lately revised by Pflüger[a] and his pupil Argutinsky, and made the subject of current discussion.

The experiments here described, especially those with J. C. W., give opportunity for comparing the amounts of energy supplied by the protein, fats, and carbohydrates oxidized in the body with the amounts of external muscular work, as is shown in the special discussion of this subject above (pages 182–187). The figures of Table 105 herewith bring out the comparison between the energy of protein and that of external muscular work.

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[a] Arch. Physiol. [Pflüger], **46** (1889–90), p. 552, and **50** (1891), p. 98. See review of this subject by Armsby, Principles of Animal Nutrition, New York, 1903, pp. 185–225.

Table 105.—*Comparison between energy of total protein oxidized and energy of external muscular work in experiments with J. C. W.—Averages per day.*

	Duration.	Heat equivalent of external muscular work.	Energy of protein oxidized.	Total energy transformed.
Carbohydrate diet.	*Days.*	*Calories.*	*Calories.*	*Calories.*
Experiment No. 37	4	506	446	4,764
Experiment No. 40	4	518	446	5,223
Experiment No. 44	4	571	440	5,199
Experiment No. 47	4	562	418	5,248
Experiment No. 49	3	515	457	5,245
Experiment No. 53	3	587	392	5,178
Average above experiments	22	543	434	5,137
Fat diet.				
Experiment No. 38	4	495	552	4,477
Experiment No. 41	4	522	543	5,242
Experiment No. 43	4	548	505	5,205
Experiment No. 45	1	577	426	5,162
Experiment No. 46	4	551	510	5,248
Experiment No. 48	1	550	462	5,218
Experiment No. 52	3	607	433	5,277
Experiment No. 54	3	595	450	5,215
Average above experiments	24	550	489	5,106
Average above 14 experiments, fat and carbohydrate diets	46	546	463	5,121
Experiment No. 50, one meal, 5 hours' work	1	307	365	4,134
Experiment No. 55, extra severe work	1	1,482	478	9,314

In the experiments summarized above the subject worked 8 hours per day on the bicycle ergometer, except in experiment No. 55, in which he worked 16 hours. The external muscular work was the power generated in the muscles of his legs and applied to the pedals of the wheel. The figures in the table show the heat equivalent of this work in each experiment and the averages of all. The essential feature is found in the comparison of the energy of the protein with that of the external work. The available energy of the protein for the day is the total amount which was liberated from the body by the cleavage and oxidation of proteid compounds during the 24 hours of each day. Of the total energy transformed in the body, only a part appears as external muscular work. Another part, which is a considerable factor of the whole, though its exact amount is not known, is used for internal muscular work, such as circulation, respiration, and peristalsis. It is hardly conceivable that all of the energy supplied by the protein during the hours of muscular work could have been transformed into the energy which was applied to the pedals through the work of the leg muscles, and still less is it possible that all of the energy coming from the protein during the 24 hours should have been concentrated upon the pedals during the 8 hours. At the same time, the total energy of the muscular work is greater than the total energy of the protein, so that even if all

of the latter has been used for external work, it would not have met the whole demand. It is thus clearly impossible that all of the muscular work should have been done at the expense of protein. Some must have come from the carbohydrates and fats. Taking into account both internal and external muscular work, the case against the theory that proteids are the sole source of muscular energy is still stronger.

A more striking example is found in experiment No. 55, though unfortunately the determinations of energy metabolized are not wholly reliable, as explained in the detailed description of the experiment on page 89. The total amount of protein katabolized, as indicated in the amount of nitrogen excreted per day in the urine, was sufficient to provide 478 calories of available energy. The period of work covered 16 hours out of the 24. The total energy transformed in the body was computed to be 9,981 calories. This, however, was on the assumption that all of the carbon lost from the body other than that derived from protein was supplied by fats, whereas there is good reason to believe that the body lost glycogen as well as fat. If such was the case, the output of energy must have been smaller. The total quantity of energy measured was 9,314 calories, but, as explained above (page 89), there is reason to believe that an experimental error reduced this observed amount below the actual output. It seems probable that the amount of energy transformed in the body during the 24 hours was somewhere between 9,314 and 9,981 calories. For the sake of argument, however, we can assume that it was only 9,314. The estimated energy from the food was 5,138 calories. The estimated energy derived from the katabolism of a reserve store of body material is estimated at 4,843 calories. These two quantities make together 9,981 calories. With so large a draft upon the body material, there was naturally a considerable draft upon the protein, so that the body lost both protein and fat. The total amount of protein in the food of the day was sufficient to supply 434 calories. The amount of nitrogen in the urine corresponded to 478 calories, thus implying that 44 calories came from body protein. Other investigations lead us to believe that when excessive muscular work makes so large a draft upon body material, not all the products of the protein katabolized are eliminated in the urine for the day, but more or less lags behind and is eliminated in the succeeding one or two days. We have no measure of the nitrogen lag in this case, but to say that the protein broken down was sufficient to supply 600 calories of energy would doubtless be a very liberal estimate. The heat equivalent of the external muscular work performed during the 16 hours of the 24 was 1,482 calories as compared with the 478 in the protein corresponding to the actual excretion of nitrogen in the urine, and, if possible, 600 in the protein katabolized in the above estimate. It seems fair to conclude, therefore, that in this case a large amount of the energy must have come from the carbohydrates and fats.

In this discussion we should not forget that only a fraction of the energy of the material katabolized in the body as the result of external muscular work appears in that form. According to the calculations made elsewhere (page 192) for every calorie which was transformed into external muscular energy, 4 calories or more were transformed into heat, and left the body in that form. Whether the ratio between total energy transformed and that which becomes muscular energy is the same for the internal muscular work of the body we have no means of knowing, but the fact that the total transformation of energy which accompanies external work is several times the amount of external work makes the demand upon material, other than protein, for energy to be used in the production of muscular labor all the greater.

The conclusions from these figures are two: (1) A considerable amount of the energy of external muscular work in these experiments must certainly have come from other material than the protein; and (2) it is in the highest degree probable that the larger part of the material which was broken down and oxidized to supply the energy of external muscular work consisted of carbohydrates and fats.

These conclusions agree fully with the general belief of physiologists, that all of the nutrients of food, proteids, fats, and carbohydrates may supply energy for muscular work, but that the chief source is in the carbohydrates and fats. They leave no basis whatever for the theory that the proteids are the sole source of muscular energy.

EFFICIENCY OF THE BODY AS A MACHINE.

The experiments here reported give data for computing the ratio of the external muscular work to the energy transformed by the body. The results which bear upon this topic are summarized in Table 106.

TABLE 106.—*Relation of external muscular work to energy katabolized—Quantities per day.*

Subject and kind of experiment.	Duration.	Energy katabolized. Total.	Energy katabolized. Excess in work over rest experiments.	Heat equivalent of external muscular work.	Efficiency.
Subject E. O.	*Days.*	*Calories.*	*Calories.*	*Calories.*	*Per cent.*
Average of 13 rest experiments	42	2,279	....	....	....
Average of 3 work experiments	12	3,892	1,613	214	13.3
Subject J. F. S.					
Average of 4 rest experiments	12	2,119	....	....	....
Average of 6 work experiments	18	3,559	1,440	233	16.2
Subject J. C. W.					
Average of 1 rest experiment	4	2,357	....	....	....
Minimum of 14 work experiments	46	5,056	2,699	529	19.6
Maximum of 14 work experiments	46	5,332	2,975	601	20.2
Average of 14 work experiments	46	5,143	2,786	546	19.6

The principle used in the above calculations is this: The body uses a certain amount of energy for the maintenance of vital functions, i. e., for its physiological work, and an additional amount for the other work which it has to do. The other work is of various kinds, and may include, in addition to what is often called external muscular work, mental exercise and nervous strain, although there is no positive evidence at present that such activity involves any considerable increase in the metabolism of matter or energy. Experiments on this topic are not numerous. A single series of experiments in this laboratory, previously reported in detail,[a] showed no larger metabolism of matter with severe intellectual labor than with the most complete rest possible. In these experiments, Nos. 4A and 4B (see list of experiments, Table 69), the subject, A. W. S., a physicist, spent twelve successive days in the respiration chamber. Nine of these days were divided into three successive periods of 3 days each, the remaining 3 days being divided between a preliminary and a supplementary period. The first of the experimental periods was devoted to severe mental work, the second to as complete rest as possible, and the third to severe muscular work. The mental labor consisted in calculating results of experiments and studying a German treatise on physics for 8 hours per day. In intensity and amount it was such as would hardly be equaled by a person not accustomed by long training to reasonably severe mental effort. Yet, as previously noticed, it exercised no apparent effect on the metabolism of matter or energy—the results of the period agreeing in all essential particulars with those of the period in which the subject rested.

It is assumed in the experiments with J. C. W. that if the mental activity involved any considerable transformation of physical energy the amount of such transformation was the same in the rest as in the work experiments. In the experiments of both classes there was a certain amount of muscular exercise involved in dressing and undressing, the care of the bed, chair, and table, and other routine operations in the respiration chamber, but such work was practically the same in both classes of experiments. Aside from it the only external muscular exercise was that of driving the ergometer, which was measured and in these discussions is taken as the total external muscular work. Its heat equivalent is given in the fourth column of Table 106. The second column shows the total energy metabolized per day. It is here assumed that the excess of energy in the work experiments over that in the rest experiments for each subject as shown in the third column represents the energy transformed for the performance of the external muscular work. The ratio of the work to the energy transformed is expressed in percentages in the last column.

[a] U. S. Dept. Agr., Office of Experiment Stations Bul. 44.

According to these figures, in Table 106, E. O. in 13 rest experiments covering 42 days katabolized 2,279 calories of energy per day. In 3 work experiments covering 12 days the energy katabolized was 3,892 calories per day. The excess, 1,613 calories, is attributed to the external muscular work, the heat equivalent of which was 214 calories, or 13.3 per cent of the excess katabolized. Of course there is no certainty that in the work experiments the katabolism other than that due to the external muscular work was exactly equal to that of the rest experiments, but this method of calculation is perhaps the best which the data permit. On this basis only a little over one-eighth of the total energy required for this external work reappeared in the work done.

Considering the body of J. F. S. in like manner as a machine, its efficiency with a slightly larger amount of external muscular work was 16.2 per cent. With J. C. W. we have only one rest experiment with food, and the basis for comparison with the work experiments is therefore less reliable. Taking the figures as they are, and remembering that the amount of work done was more than double that with either of the other subjects, it appears that in the average of 14 experiments, covering in all 46 days, during which he worked 8 hours and applied muscular power equivalent to 546 calories of energy per day to the pedals of the bicycle ergometer, he more than doubled the amount of energy transformed in the body and applied 19.6 per cent of this energy to the pedals.

It is interesting to note that this ratio of efficiency with J. C. W. was very nearly constant. Thus in 4 experiments, covering 16 days, with an average external work corresponding to 529 calories, the efficiency was the same as in the average for the total. In 2 experiments, covering 6 days, with external work corresponding to 601 calories, the efficiency was 20.2 per cent. No less interesting are the figures for experiment No. 55, which are not included in the table because of probable errors in the data for amounts of total energy transformed. The details of this experiment, which was of only a single day, are given on pages 88–97. Of the 24 hours of this experiment 16 (not continuous) were spent in driving the ergometer. The work was not only long continued but was severe, as is evidenced by the heat equivalent, which was 1,482 calories, and by the energy metabolized, which was estimated at 9,981 and measured as 9,314 calories. It is probable that neither of these figures is correct and that the true value lies between them. The efficiency indicated by the smaller figure is 21.3 and by the larger 19.4 per cent.

It appears that whatever was the amount of work which J. C. W. did with the muscles used in turning the wheel of the bicycle he transformed about 5 calories of energy in his body for every one which was utilized in the performance of mechanical work.

In all these cases the subjects were fairly efficient machines, as will be seen when it is remembered that the ordinary steam engine transforms only about 15 per cent of the energy of the fuel into work. It is quite possible that something more satisfactory than the ergometer may be devised for utilizing the external muscular work performed by the subject.

CONSERVATION OF ENERGY IN THE BODY.

In the original planning of the experiments described in the series of reports of which the present is the fourth, the first purpose was to develop an apparatus and method for the measurement of the energy transformed in the body. The underlying thought was that if these measurements could be made accurately they might serve to show that the law of the conservation of energy obtains in the body, a principle which is generally believed but was thought by not a few physiologists to lack complete demonstration. If this could be accomplished the principle and the apparatus it was felt could be utilized for a more successful study of some of the fundamental laws of nutrition than would otherwise be possible.

The investigations of Rubner[a] in Germany and of Laulanie[b] in France had brought results fully in accordance with the law of the conservation of energy, but their experiments were made with small animals, dogs and rabbits, and were comparatively few in number; the experimental periods were rather short; the analyses of food, drink, and excreta were not carried out in great detail, and no experiments were made in which external muscular work was involved.

It was felt that the demonstration would be more nearly complete, and on the whole much more satisfactory if the experiments could be made with men as subjects who were familiar with the methods of scientific research; if the experimental periods could cover several days each instead of being limited to a day or part of a day; if complete analyses could be made of the food, drink, and excretory products, the heats of combustion of the unoxidized materials being likewise directly determined in each case; if the experiments could cover different conditions as regards food and fasting, work and rest; if external muscular work could be performed and measured, and finally if the experiments could be repeated with the same subject and with different subjects. So extensive a programme was perhaps unnecessary for the study of a question about which there was really little doubt, and even the experiments which have been reported may not suffice for the final and absolute demonstration—that the law of the conservation of energy obtains in the body, but it will be worth while to consider what they do show.

[a] Ztschr. Biol., **30** (1894), p. 73.

[b] Arch. Physiol., Paris (1898), p. 748.

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Income and outgo of energy in the body.—These experiments compare the amounts of potential energy in the materials actually oxidized in the body with the amounts of kinetic energy given off from it, either as heat alone in the rest experiments or as heat and external muscular work in the work experiments.

In the rest experiments there was no considerable amount of external muscular work. The little that was done would naturally be converted into heat, as, for instance, in the impact of the foot upon the floor in stepping, or of the body upon the chair or bed in sitting or lying down. The heat thus imparted to the floor, chair, or bed would eventually find its way to the heat absorbers, and would thus be carried out with the heat given off as such by the body. Roughly speaking, we may say that all the potential energy made kinetic in the body by the oxidation of food and body material left the body as heat, and that this made the net outgo of energy.

In the work experiments a certain amount of energy is given off as external muscular work, and this added to the heat given off from the body makes the net outgo.

Table 107 compares the net income and outgo of energy in 45 of the 51 respiration calorimeter experiments designated in the text on page 119 as Nos. 5–55, the omissions being the fasting experiments with J. C. W., in which the uncertainty as to the amount of carbohydrates (glycogen) lost by the body makes the comparison doubtful, and Nos. 50 and 55, also with J. C. W., in each of which there was an evident error in the heat measurement.

TABLE 107.—*Comparison of income and outgo of energy in 45 metabolism experiments covering 143 experimental days—Average amounts per day.*

Subject and kind of experiment.	Duration.	Net income (potential energy of material oxidized in the body).	Net outgo (kinetic energy given off from the body).	Difference (in terms of net income).	
Ordinary diet.					
REST EXPERIMENTS.	*Days.*	*Calories.*	*Calories.*	*Calories.*	*Per cent.*
7 experiments with E. O	25	2,268	2,259	− 9	−0.4
1 experiment with A. W. S	3	2,304	2,279	−25	−1.1
3 experiments with J. F. S	9	2,118	2,136	+18	+0.8
1 experiment with J. C. W	4	2,357	2,397	+40	+1.7
Average of 12 experiments with E. O., A. W. S., J. F. S., and J. C. W	41	2,246	2,246	0	0.0
WORK EXPERIMENTS.					
2 experiments with E. O	8	3,865	3,829	−36	−0.9
4 experiments with J. F. S	12	3,539	3,540	+ 1	0.0
14 experiments with J. C. W	46	5,120	5,120	0	0.0
Average of 20 experiments with E. O., J. F. S., and J. C. W	66	4,682	4,676	− 6	−0.1
Average of all rest and work experiments (32) with ordinary diet	107	3,748	3,745	− 3	−0.1

TABLE 107.—*Comparison of income and outgo of energy in 45 metabolism experiments covering 143 experimental days—Average amounts per day*—Continued.

Subject and kind of experiment.	Duration.	Net income (potential energy of material oxidized in the body).	Net outgo (kinetic energy given off from the body).	Difference (in terms of net income).	
Special diet.					
REST EXPERIMENTS.	*Days.*	*Calories.*	*Calories.*	*Calories.*	*Per cent.*
6 experiments with E. O	17	2,313	2,319	+ 6	+0.3
3 experiments with A. W. S	6	2,308	2,356	+48	+2.1
1 experiment with J. F. S	3	2,124	2,123	− 1	0.0
Average of 10 experiments with E. O., A. W. S., and J. F. S	26	2,290	2,305	+15	+0.7
WORK EXPERIMENTS.					
1 experiment with E. O	4	3,922	3,928	+ 6	+0.2
2 experiments with J. F. S	6	3,583	3,552	−31	−0.9
Average of 3 experiments with E. O. and J. F. S	10	3,719	3,702	−17	−0.5
Average of all rest and work experiments (13) with special diet	36	2,687	2,695	+ 8	+0.3
Average of all rest and work experiments (45) all diets	143	3,481	3,481	0	0.0

The figures for income and outgo of energy require a word of explanation. A distinction is here made between the total[a] income, which is represented by the potential energy of the food, and the net income which is the energy of the material actually oxidized in the body. This energy of net income is represented by the available energy of the nutrients of the food (i. e., potential energy of total food less that of the urine and feces) minus the potential energy of the material gained or plus that of material lost by the body when the latter is not in nitrogen and carbon equilibrium. The total energy of outgo would be the kinetic energy given off from the body in heat and as external muscular work plus the potential energy of the unoxidized materials in the urine and the feces. The net energy of outgo consists of the heat given off and the external muscular work done. The balance of income and outgo is best shown by the net rather than the total quantities, as is the case in Table 107.

As suggested in the paragraph above, the net income of energy depends upon two factors: The available energy of the food, and the energy of body material stored or lost, the latter being added to the former when the body loses material and subtracted when it gains. The available energy of food is found from direct determinations, by

[a] The terms "total" and "net" here applied to income and outgo of material and energy are used for present convenience, and may in future reports be replaced by more satisfactory expressions.

subtracting from the heat of combustion of the food the heats of combustion of the feces and urine, all of which are measured by use of the bomb calorimeter. Since these measurements are reasonably exact the accuracy of this factor of net income of energy depends upon the closeness with which the feces and urine correspond with the food, and it is believed that under the conditions of the experiments this agreement is close, and that the figures for available energy of the food are near the truth. The amounts of body material stored or lost are calculated from the gains or losses of nitrogen and carbon by use of factors representing the elementary composition of body protein and fat; and their energy is likewise calculated by use of factors based upon direct determinations of the heats of combustion of similar substances. While there is a possibility of error in these factors they are based upon the best available data, and the calculated results are believed to vary but little from the actual facts.

The figures for net outgo of energy represent the heat given off as such when the body is at rest, and this plus the energy of external muscular work when work is performed. Inasmuch as the energy of external muscular work is converted into heat in the calorimeter, it is measured as such together with that given off by the body. The net outgo of energy is therefore determined entirely by actual measurement.

A common usage is followed in applying the term "potential energy" to the energy latent in the food and body material oxidized. Whether chemical energy would or would not be a more correct expression no attempt is here made to decide. Ordinary usage is also followed in expressing potential energy in terms of heat—i. e., as calories—thus employing a unit of kinetic energy for the measurement. This though unsatisfactory is unavoidable, since we have neither the means for measuring potential energy as such, nor a unit for expressing the measurements if they were made. The use of heat of oxidation for the measure is especially appropriate here, since the energy is liberated mainly by oxidation and appears chiefly or entirely as heat.

If the law of the conservation of energy obtains in the living organism, the net income and the net outgo of energy should be the same. In such physiological experimenting, however, it would be hardly fair to expect the figures for the two to agree for each day of a given experiment or for each experiment as a whole, even if the measurements with the respiration and bomb calorimeters are exact. There may be errors in the estimates of the amounts and heats of combustion of the materials actually oxidized. Variations due to irregularities of the physiological processes of the body are unavoidable, and may materially affect the results. For instance, the calculations assume that the quantities of material in the alimentary canal and the amounts

of carbohydrates in the body as a whole are the same at the end as at the beginning of each day or experiment, whereas they may differ considerably, and the differences would materially affect the results. But it might be hoped that if the methods are correct these errors would tend to counterbalance one another in a series of experiments, and that in the average of a sufficiently large number of experiments the errors would thus be offset, so that the income and outgo would be very nearly the same.

Exactly this is the case in the data here reported. The variations for individual days, and even those for the individual experiments, as shown in the detailed tables in this and the previous bulletins, are not inconsiderable, but considering the average of all the experiments the agreement is very close. Thus, in the 25 days of the 7 rest experiments with ordinary diet with E. O., according to the figures for the individual days the net outgo varies from 165 calories below to 194 calories above the net income. Expressed in percentages of net income, the range here is from −6.5 to +9.1 per cent. Both these extremes occurred on the first days of the respective experiments and, in general, it may be said that the results for the first day of an experiment are found to be less satisfactory than those for the succeeding days. Considering each experiment as a whole, and comparing the averages of the several experiments one with another, the range of variation is less. Here the net outgo varies from 103 calories below to 62 calories above the net income per day. Expressed in percentages of net income, the range is from −4.1 to +2.9 per cent. But in the average for the 9 experiments the figures for the net income and outgo are practically the same, being 2,268 and 2,259, calories, respectively.

The percentage discrepancies in the individual experiments with E. O. are the largest we have found. They occurred in the early experiments which were largely given up to the development of experimental methods. That the variations are less in the later experiments may be seen by examining the details of the experiments with J. C. W. as given in Table 126 of the Appendix. Remembering that the fasting experiments Nos. 36, 39, 42, and 51, and the exceptional experiments Nos. 50 and 55, are not to be included in the comparisons for the reasons stated above, the widest variations in single days are from +231 to −258 calories, or from +4.6 to −4.7 per cent, and the widest in the individual experiments of more than one day from +157 to −96 calories, or from +3.1 to −2.1 per cent of the net income in each case.

The way in which the errors compensate each other is illustrated by the data in Table 107, in which the averages are obtained as usual, not by averaging the averages of individual experiments or groups of experiments, but by dividing the sum totals in each class by the corresponding

numbers of days, as in the instance above cited. The sum totals from which the averages for the several classes of experiments in Table 107 were obtained are given in Table 108. The sum totals for the experiments with J. C. W., which were the latest and therefore represent the advantage of accumulated experience in the development of apparatus and method, are appended.

TABLE 108.—*Total income and outgo of energy in metabolism experiments with the respiration calorimeter.*

Subjects and kind of experiments.	Duration.	Income.	Outgo.	Difference in terms of net income.	
Ordinary diet.					
REST EXPERIMENTS.	*Days.*	*Calories.*	*Calories.*	*Calories.*	*Per ct.*
7 experiments with E. O	25	56,700	56,467	−233	−0.2
1 experiment with A. W. S	3	6,912	6,837	− 75	− .9
3 experiments with J. F. S	9	19,059	19,226	+167	+ .9
1 experiment with J. C. W	4	9,430	9,588	+158	+1.7
Total 12 experiments with 4 subjects	41	92,101	92,118	+ 17	−
WORK EXPERIMENTS.					
2 experiments with E. O	8	30,919	30,631	−288	− .9
4 experiments with J. F. S	12	42,566	42,484	− 82	− .2
14 experiments with J. C. W	46	235,497	235,507	+ 10	−
Total 20 work experiments with 3 subjects	66	308,982	308,622	−360	− .1
Total 32 rest and work experiments with 4 subjects	107	401,083	400,740	−343	− .1
Special diet.					
REST EXPERIMENTS.					
6 experiments with E. O	17	39,313	39,424	+111	+ .3
3 experiments with A. W. S	6	13,851	14,139	+288	+2.1
1 experiment with J. F. S	3	6,373	6,370	− 3	−
Total 10 experiments with 3 subjects	26	59,537	59,933	+396	+ .7
WORK EXPERIMENTS.					
1 experiment with E. O	4	15,688	15,710	+ 22	+ .1
2 experiments with J. F. S	6	21,497	21,309	−188	− .9
Total 3 experiments with 2 subjects	10	37,185	37,019	−166	− .4
Total 13 rest and work experiments with 3 subjects	36	96,722	97,012	+290	+ .3
All diets.					
Total 45 rest and work experiments with 4 subjects	143	497,805	497,752	− 53	−

In the average of the 12 rest experiments with ordinary food covering 41 days, the sum total of the figures of daily income is 92,101 and for outgo 92,118, so that when the averages per day are found by dividing these numbers by 41, omitting fractions of a calorie, the figures for the two are the same, namely, 2,246 calories. A similar identity is found in the work experiments with J. C. W., for in the average of all the experiments (32 covering 107 days), with ordinary

diet, the daily income is 3,748 and the outgo 3,745 calories, making a difference of 3 calories or less than 0.1 per cent of the whole.

In the experiments with special diet the average daily outgo exceeded the income by 15 calories, in the work experiments it fell short by 17 calories, in the average of both work and rest experiments (18 covering 36 days) there was an excess of 8 calories or 0.3 per cent of the whole. The difference in all the experiments is 55 calories in nearly 500,000, or about 1 in 10,000, and in those with J. C. W., which were the latest experiments, and are believed to be more satisfactory than those previously made, it was about 1 in 20,000. It is clear that with increase in experience and in the number of experiments the total averages of income and outgo approach each other more nearly, and that the grand totals may be regarded as identical.

Of course such discrepancies as have been pointed out are far within the limits of experimental error and physiological uncertainty. As was said in a similar summary in a previous publication of this series,[a] the agreement of average results is much closer than was originally hoped for, and it is by no means certain that future averages will show so exact a balance.

The electrical and alcohol check tests described earlier (pages 34–39) show that the measurements of energy by the apparatus, though subject to minor errors in short periods, become nearly exact when several tests are averaged. Thus in the average of the tests made by burning alcohol within the apparatus, the quantity of heat measured was almost exactly 100 per cent of the amount calculated to be given off by the combustion of the alcohol; and a corresponding close agreement was found between the quantity of heat generated electrically within the chamber and that measured by the calorimeter. It thus seems certain that the respiration calorimeter itself is an apparatus of precision. The results reached by its aid are fully as accurate and reliable as those ordinarily obtained in the use of what are considered well-developed forms of apparatus and methods in the chemical laboratory. They are not equal in refinement to those used in the most accurate determinations of atomic weights, they do not compare with the best physical measurements, nor are they yet by any means perfected as agencies for the special forms of research for which they were intended. The errors found in the results of individual tests are much larger and more numerous than is to be desired, and attempts toward improvement are constantly being made. Indeed, much more labor has been given to the development and testing of apparatus and methods during the past eleven years than to actual experiments with men, and much more will have to be done in coming years to the same end. The direct determination of the amount of oxygen used in metab-

[a] U. S. Dept. Agr., Office of Experiment Stations Bul. 109.

olism is one of the problems which especially needs solving, and it has now been taken up. But so far as the measurements of the energy given off from the body in the forms of heat and the heat equivalent of muscular work are concerned the apparatus serves its purpose very well. This means that the net outgo of energy is measured with reasonable accuracy, especially when the results for long periods are available.

The same may be said of the determinations with the bomb calorimeter as developed and used in this laboratory for the measurement of the potential energy of food and unoxidized excreta. This factor of the net income of energy is certainly reliable. The other factors of net income are less certain because of the possible sources of error on the physiological side, to which reference has been frequently made in these discussions. It seems probable that the chief of these uncertainties are those due to (1) the amounts of material in the alimentary canal, which may vary considerably from day to day at 7 a. m. when the experiments begin and end; (2) the possible error in assumed composition of protein and fats gained or lost in the body, though this error is probably small, and (3) the variations in the proportions of carbohydrates (glycogen) in the body which are not definitely measured in these experiments. The direct determination of oxygen, which by means of improvements and recent appliances to the respiration calorimeter is being made in experiments subsequent to those here reported, will, it is hoped, help to remove this latter difficulty in future work. Meanwhile it seems safe to say that in the investigations here summarized the length of the experimental periods and the repetitions of the experiments with the same subject and with different subjects, and the number of results included in the averages, give to the latter an authority that can not well be disputed. It seems fair to assume, therefore, that the figures for income of energy as summarized in Table 107 are not far from correct.

It is probably useless to hope that the transformations of matter and energy in the body will ever be measured with the accuracy of chemical and physical processes in the laboratory, especially in individual experiments of short duration. Certainty and exactitude must be sought in repeated and long continued series. This statement applies to comparisons of income and outgo of energy. The net outgo may be measured exactly with the respiration calorimeter, but the net income is influenced by physiological factors for which there is little hope of exact determination except with aid of "the might of average figures" from numerous experiments. But with such repetitions reasonably close results can be obtained. It would seem that this consummation has been approached if not attained in the experiments with men above described.

The agreement of the totals and averages of income and outgo of energy in the different classes of experiments as shown in Table 107 can hardly be without significance. Reduced to their simplest terms, the results of these experiments show that the energy given off from the body in the two forms of heat and external muscular work equals the potential energy of the materials oxidized. The natural inference is that practically all the energy transformed in the body appears as heat or heat and external work. Two possibilities stand in the way of the acceptance of these results as a positive demonstration of the conservation of energy in these experiments and the natural corollary that it must obtain generally in the living organism. The first is that the measurements of energy may have been inaccurate. As regards this enough has been said to show the great improbability of any considerable error in the measurements of either income or outgo. The other is that some form of kinetic energy concerned in the transformations may have escaped measurement. If there be such it must have belonged to the outgo. The question then is, Was any form of kinetic energy other than heat and muscular work produced within the body and given off by it?

Light and electrical energy are emitted by some of the lower animals, but it can hardly be assumed that any considerable amount of either is given off from the human body under ordinary conditions. It has been suggested that intellectual activity and nervous tension may be manifestations of some special forms of physical energy, the character of which is not yet understood. If such be the case any energy which is due to internal mental or nervous work must be transformed within the body, and unless retained by some form of storage of which we have no conception it must be eliminated. It might be transformed into heat and leave the body in that form as is the case with the energy of internal muscular work; in that case it would be measured with the other heat given off from the body, or it might be eliminated in some other form unknown to us. In that case it must either pass through the copper wall of the respiration chamber without being changed to heat or it must have been changed to heat and measured, provided the quantity was large enough for measurement. In other words, the quantity must either have been extremely minute or it must be something the nature of which physical research has not revealed.

The theory has been lately advanced that the body emits some form of energy in which rays of great wave length are concerned and recent discoveries and conjectures regarding such forms of energy are of a kind to incite if not encourage such speculative hypotheses; but here again any acceptance of the common views regarding the laws of physical energy compels the assumption that if energy of this sort is

emanated from the body, the whole amount must be at most very slight and the quantity that could pass the copper walls of the calorimeter in the experiments reported without being measured as heat must be not only within the limits of experimental error but also too small for measurement by any ordinary means.

The conclusion is that if the law of the conservation of energy did not obtain completely in these experiments the variations from it have been far too small to bear any comparison with the total energy transformed, and making all allowance for errors, etc., the experiments may be fairly said to demonstrate that the law of the conservation of energy held good as regards the men who were studied. For practical purposes we are therefore warranted in assuming that the law obtains in general in the living organism, as indeed there is every reason *a priori* to believe that it must

APPENDIX.

The data from which the tables in the preceding chapters are derived are given in detail in Tables 109–127, which follow. The order of sequence of the experiments and their general character and classification are shown in the chronological list given on page 101.

COMPOSITION OF FOOD MATERIALS, FECES, AND URINE.

The figures for the analyses of the food materials and feces of the experiments here reported are given in Tables 109 and 110. The data for the elementary composition of the feces in all the metabolism experiments are summarized in Tables 111 and 112. The methods of analysis are mainly those adopted by the Association of Official Agricultural Chemists, with such modifications as have been found necessary or desirable.

TABLE 109.—*Composition of food materials used in metabolism experiments Nos. 35–55.*

Laboratory No.	Food materials.	Experiment No.	Nitrogen.	Carbon.	Hydrogen.	Water.	Protein.	Fat.	Carbohydrates.	Ash.	Heat of combustion per gram.
			P. ct.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*Cals.*
3241	Beef	35	5.62	20.05	2.90	61.2	35.1	3.1	....	1.0	2.269
3251	.....do	37–38	5.46	19.95	2.89	61.3	34.1	2.8	....	.9	2.249
3263	.....do	37–38	5.26	19.23	2.82	63.3	32.9	2.7	....	.9	2.128
3296	.....do	40–41	5.44	19.66	2.81	61.8	34.0	2.9	....	.9	2.200
3309	.....do	43–45	5.26	19.24	2.82	62.9	32.9	2.9	....	.9	2.162
3340	.....do	46–48	5.39	19.53	2.90	62.1	33.7	2.8	....	1.0	2.192
3242	Butter	35	.30	63.10	10.00	10.5	1.9	84.6	....	3.1	7.751
3253	.....do	37–38	.30	62.58	9.93	12.2	1.4	84.3	....	2.1	7.718
3298	.....do	40–41	.22	63.71	10.23	10.3	1.4	86.0	....	2.3	7.909
3310	.....do	43–45	.19	62.86	10.32	11.1	1.2	85.0	....	2.7	7.874
3341	.....do	46–48	.20	65.71	7.67	8.6	1.2	87.4	....	2.8	8.084
3418	.....do	49–50	.22	65.03	10.40	9.0	1.4	87.6	....	2.0	8.070
3431	.....do	52–55	.21	65.38	10.34	9.0	1.3	86.9	....	2.8	8.110
3252	Deviled ham	38	2.46	39.21	6.15	38.5	15.4	41.3	....	4.1	4.741
3244	Milk	35	.60	7.97	1.17	85.5	3.8	5.3	4.7	.7	.903
3255	.....do	37	.56	8.53	1.23	84.8	3.5	5.5	5.5	.7	.944
3262	.....do	38	.56	8.20	1.23	84.9	3.5	5.0	5.9	.7	.912
3300	.....do	40	.60	7.94	1.18	85.1	3.9	5.2	5.1	.7	.923
3301	.....do	41	.59	8.02	1.24	85.3	3.7	5.3	5.0	.7	.911
3312	.....do	43	.62	7.97	1.25	84.8	3.9	5.5	5.1	.7	.920
3313	.....do	44	.61	8.27	1.28	84.3	3.8	5.6	5.6	.7	.940
3319	.....do	45	.64	8.35	1.26	84.3	4.0	5.3	5.7	.7	.915
3343	.....do	46	.62	7.69	1.20	85.5	3.9	5.5	4.4	.7	.860
3344	.....do	47	.62	7.86	1.21	85.2	3.9	5.0	5.2	.7	.881

TABLE 109.—*Composition of food materials used in metabolism experiments Nos. 35–55*—Continued.

Laboratory No.	Food materials.	Experiment No.	Nitrogen.	Carbon.	Hydrogen.	Water.	Protein.	Fat.	Carbohydrates.	Ash.	Heat of combustion per gram.
			P. ct.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*Cals.*
3345	Milk	48	0.62	8.50	1.17	85.2	3.9	4.8	5.4	0.7	0.874
3424	....do	49–50	.65	8.09	1.20	85.0	4.1	5.0	5.2	.7	.906
3436	....do	52	.60	7.60	1.16	85.6	3.7	4.9	5.0	.8	.848
3437	....do	53	.58	7.53	1.16	85.8	3.6	5.1	4.7	.8	.838
3438	....do	54–55	.61	8.04	1.22	84.7	3.8	5.8	4.9	.8	.880
3440	Cream	52	.41	19.06	2.95	70.0	2.6	21.5	5.3	.6	2.322
3441	....do	54–55	.46	20.31	3.16	68.0	2.9	23.1	5.4	.6	2.472
......	Beef tea	50	.21	.24	.05	99.1	.6	......	....	.3	.028
......	....do	51	.13	.15	.03	99.4	.4	......	....	.2	.018
......	....do	51	.21	.24	.05	99.1	.6	......	....	.3	.027
......	....do	55	.14	.16	.03	99.4	.4	......	....	.2	.019
3245	Bread	35	1.30	27.51	4.08	41.3	7.4	4.0	46.4	.9	2.783
3256	....do	37–38	1.26	26.52	3.83	42.7	7.2	2.3	46.9	.9	2.671
3302	....do	40–41	1.29	25.27	3.68	43.5	7.4	1.2	46.9	1.0	2.533
3314	....do	43–45	1.42	25.91	3.87	42.5	8.1	1.1	47.3	1.0	2.609
3346	....do	46–48	1.27	26.08	3.68	42.6	7.2	1.6	47.7	.9	2.618
3419	....do	49–50	1.50	26.15	3.84	41.6	8.6	1.8	46.7	1.3	2.643
3432	....do	52	1.46	25.83	3.81	43.1	8.3	1.5	46.1	1.0	2.605
3433	....do	53–55	1.50	26.60	3.92	41.6	8.5	1.7	47.2	1.0	2.663
3247	Ginger snaps	35–38	.99	42.23	6.13	6.7	5.6	7.1	78.4	2.2	4.241
3305	....do	40–48	1.05	42.90	6.64	4.0	6.0	5.6	82.0	2.4	4.323
3420	....do	49–55	1.08	42.62	6.37	5.5	6.2	6.3	78.8	3.2	4.261
3257	Graham crackers	37	1.40	45.92	6.80	3.3	8.0	10.2	77.2	1.3	4.645
3303	....do	40, 41, 44, 47	1.56	45.37	6.69	2.7	8.9	10.9	74.6	2.9	4.673
3422	....do	49, 52–55	1.37	44.90	6.82	3.2	7.8	11.6	74.7	2.7	4.602
3246	Shredded wheat	35, 37, 38	1.68	40.93	5.75	8.2	9.6	1.4	79.4	1.4	4.074
3304	....do	40, 41, 43–45	1.80	41.74	6.35	6.2	10.3	1.6	80.4	1.5	4.100
3347	....do	46–48	1.75	41.46	6.41	8.0	10.0	1.3	79.5	1.2	4.050
3421	....do	49, 50, 52–55	1.84	40.86	5.93	8.0	10.5	1.3	78.2	2.0	4.006
3321	Cereal coffee	43–45	.01	.33	.05	99.3	.1	......	.6	......	.034
3348	....do	46–48	.01	.47	.07	98.9	.1	......	1.0	......	.046
3425	....do	49–50	.01	.30	.04	99.3	.1	......	.6	......	.032
3434	....do	52–55	.01	.29	.04	99.3	.1	......	.6	......	.028
......	Cane sugar	35–55	......	42.10	6.48	......	......	......	100.0	......	3.960
3258	Milk sugar	35–55	......	40.00	6.15	5.1	......	......	94.9	......	3.719

TABLE 110.—*Composition of feces in metabolism experiments Nos. 35–55.*

Laboratory No.		Experiment No.	Nitrogen.	Carbon.	Hydrogen.	Water.	Protein.	Fat.	Carbohydrates.	Ash.	Heat of combustion per gram.
			Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Calories.*
3249	Feces	35	1.14	10.10	1.44	78.6	7.1	4.1	6.4	3.8	1.114
3260	do	37	1.43	11.25	1.58	76.5	8.9	3.8	7.2	3.6	1.220
3261	do	38	.94	11.42	1.68	76.4	5.9	5.8	6.5	5.4	1.297
3307	do	40	1.32	10.77	1.52	77.4	8.2	3.5	7.8	3.1	1.178
3308	do	41	.79	11.39	1.71	78.4	5.0	6.6	5.9	4.1	1.346
3316	do	43	.88	8.98	1.33	82.4	5.5	3.4	5.5	3.2	1.016
3317	do	44	1.24	8.75	1.21	81.6	7.8	2.0	6.2	2.4	.950
3320	do	45	.81	8.63	1.26	83.3	5.0	3.0	5.8	2.9	.994
3350	do	46	.78	8.70	1.23	83.4	4.9	5.0	3.7	3.0	.988
3351	do	47	1.15	8.35	1.16	82.7	7.2	1.6	6.3	2.2	.887
3352	do	48	.78	10.14	1.47	80.5	4.9	5.6	5.5	3.5	1.172
3428	do	49	.97	8.06	1.11	82.9	6.1	2.1	6.0	2.9	.839
3429	do	50	.94	9.70	1.42	80.5	5.9	3.7	6.0	3.9	1.114
3443	do	52	.63	8.43	1.24	84.0	4.0	2.6	6.1	3.3	.973
3444	do	53	.88	7.95	1.10	83.7	5.5	2.5	5.7	2.6	.860
3445	do	54–55	.77	10.07	1.47	80.5	4.8	3.4	7.5	3.8	1.168

TABLE 111.—*Composition of feces in metabolism experiments Nos. 5–55.*

Subject and kind of experiment.	Water-free substance.						Water and ash free substance.				
	Nitrogen.	Carbon.	Hydrogen.	Oxygen (by difference).	Ash.	Energy per gram.	Nitrogen.	Carbon.	Hydrogen.	Oxygen (by difference).	Energy per gram.
Subject E. O.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*Cals.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*Cals.*
Experiment No. 5, fat diet, rest	6.01	50.18	6.74	18.85	18.22	5.220	7.35	61.36	8.24	23.05	6.381
Experiment No. 6, fat diet, work	6.03	49.75	7.34	19.80	17.08	5.578	7.27	60.00	8.85	23.88	6.728
Experiment No. 7, special diet, rest	6.27	46.34	6.10	23.87	17.42	5.279	7.60	56.12	7.38	28.90	6.393
Experiment No. 8, carbohydrate diet, rest	5.82	49.19	6.74	19.65	18.60	5.430	7.14	60.43	8.29	24.14	6.671
Experiment No. 9, carbohydrate diet, rest	4.35	46.48	6.44	26.20	16.53	4.953	5.21	55.68	7.72	31.39	5.934
Experiment No. 10, special diet, rest	5.40	46.37	6.29	25.24	16.70	4.990	6.49	55.66	7.55	30.30	5.991
Experiment No. 11, carbohydrate diet, work	5.45	48.79	6.79	24.43	14.54	5.303	6.38	57.10	7.94	28.58	6.206
Experiment No. 12, special diet, work	5.22	50.42	7.10	20.56	16.70	5.689	6.27	60.53	8.52	24.68	6.830
Experiment No. 13, carbohydrate diet, rest	4.92	49.78	7.15	12.82	25.33	5.589	6.59	66.66	9.58	17.17	7.485
Experiment No. 14, carbohydrate diet, rest	6.02	52.21	7.08	20.53	14.16	5.806	7.01	60.82	8.25	23.92	6.764
Experiments Nos. 15–17, special diet, rest	5.00	46.80	6.50	17.70	24.00	5.280	6.58	61.58	8.55	23.29	6.948
Subject A. W. S.											
Experiments Nos. 18–21, special diet, rest	5.89	51.27	7.03	18.70	17.11	5.735	7.11	61.86	8.48	22.55	6.920
Subject E. O.											
Experiments Nos. 22–23, special diet, rest	5.20	46.98	6.73	18.13	22.96	5.241	6.75	60.98	8.74	23.53	6.803
Experiment No. 24, carbohydrate diet, rest	5.95	47.87	6.86	19.50	19.82	5.290	7.41	59.70	8.56	24.33	6.597

TABLE 111.—*Composition of feces in metabolism experiments Nos. 5–55*—Continued.

Subject and kind of experiment.	Water-free substance.						Water and ash free substance.				
	Nitrogen.	Carbon.	Hydrogen.	Oxygen (by difference).	Ash.	Energy per gram.	Nitrogen.	Carbon.	Hydrogen.	Oxygen (by difference).	Energy per gram.
Subject J. F. S.											
	P. ct.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*Cals.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*Cals.*
Experiment No, 25, carbohydrate diet, rest	4.42	44.20	6.56	20.43	24.39	5.061	5.85	58.46	8.67	27.02	6.694
Experiment No. 26, fat diet, rest	5.04	43.20	5.19	22.14	24.43	4.840	6.67	57.17	6.87	29.39	6.404
Experiment No. 27, special diet, rest	4.94	40.12	3.59	24.10	27.25	4.372	6.79	55.15	4.94	33.12	6.009
Experiment No. 28, carbohydrate diet, rest	5.72	46.22	6.18	21.79	20.09	5.178	7.16	57.83	7.74	27.27	6.480
Experiment No. 29, carbohydrate diet, work	4.88	46.90	6.75	22.70	18.77	5.235	6.00	57.74	8.31	27.95	6.444
Experiment No. 30, special diet, work	4.87	46.96	6.57	22.14	19.46	5.158	6.04	58.30	8.16	27.50	6.405
Experiment No. 31, fat diet, work	4.62	46.73	6.54	20.96	21.15	5.231	5.85	59.28	8.29	26.58	6.634
Experiment No. 32, fat diet, work	4.58	47.97	7.00	21.37	19.08	5.408	5.66	59.28	8.65	26.41	6.682
Experiment No. 33, special diet, work	4.67	45.60	6.67	21.73	21.33	5.000	5.93	57.97	8.47	27.63	6.356
Experiment No. 34, carbohydrate diet, work	4.60	45.66	6.45	22.24	21.05	4.961	5.83	57.84	8.17	28.16	6.284
Subject J. C. W.											
Experiment No. 35, carbohydrate diet, rest	5.79	47.17	6.74	22.57	17.73	5.201	7.04	57.33	8.19	27.44	6.322
Experiment No. 37, carbohydrate diet, work	6.47	47.85	6.78	23.50	15.40	5.196	7.65	56.56	8.01	27.78	6.141
Experiment No. 38, fat diet, work	4.31	48.39	7.09	17.77	22.44	5.494	5.55	62.39	9.14	22.92	7.084
Experiment No. 40, carbohydrate diet, work	6.16	47.67	6.73	25.84	13.60	5.211	7.13	55.18	7.79	29.90	6.032
Experiment No. 41, fat diet, work	3.91	52.74	7.89	16.58	18.88	6.238	4.82	65.01	9.73	20.44	7.690
Experiment No. 43, fat diet, work	5.28	51.07	7.53	18.09	18.03	5.776	6.44	62.30	9.19	22.07	7.047
Experiment No. 44, carbohydrate diet, work	6.97	47.60	6.58	25.97	12.88	5.166	8.02	54.63	7.55	29.80	5.930
Experiment No. 45, fat diet, work	5.12	51.62	7.44	19.54	16.28	5.954	6.11	61.66	8.89	23.34	7.111
Experiment No. 46, fat diet, work	5.00	52.40	7.42	17.14	18.04	5.954	6.10	63.94	9.06	20.90	7.265
Experiment No. 47, carbohydrate diet, work	6.92	48.26	6.73	25.16	12.93	5.143	7.95	55.42	7.73	28.90	5.907
Experiment No. 48, fat diet, work	4.28	52.03	7.50	19.06	17.13	5.996	5.17	62.79	9.04	23.00	7.236
Experiment No. 49, carbohydrate diet, work	5.95	47.13	6.49	23.43	17.00	4.900	7.17	56.78	7.81	28.24	5.904
Experiment No. 50, fat diet, work	5.27	49.68	7.28	17.68	20.09	5.714	6.59	62.18	9.11	22.12	7.151
Experiment No. 52, fat diet, work	4.18	52.72	7.73	14.75	20.62	6.080	5.26	66.40	9.75	18.59	7.660
Experiment No. 53, carbohydrate diet, work	5.65	48.79	6.77	22.82	15.97	5.274	6.72	58.06	8.06	27.16	6.276
Experiments Nos. 54 and 55, fat diet, work	4.20	51.70	7.55	17.07	19.48	5.993	5.22	64.21	9.37	21.20	7.443
Average of all experiments	5.33	48.38	6.71	20.79	18.79	5.377	6.54	59.58	8.34	25.54	6.623

Table 112.—*Amounts of carbon, oxygen, and hydrogen, total organic matter and energy, corresponding to 1 gram of nitrogen, and energy per gram of carbon in feces, metabolism experiments Nos. 5–55.*

Subject and kind of experiment.	Amounts per gram of nitrogen.					Energy per gram of carbon.
	Carbon.	Hydrogen.	Oxygen (by difference).	Organic matter.	Energy.	
Subject E. O.	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Calories.*	*Calories.*
Experiment No. 5, fat diet, rest	8.348	1.121	3.136	13.605	86.82	10.40
Experiment No. 6, fat diet, work	8.250	1.217	3.283	13.750	92.50	11.21
Experiment No. 7, special diet, rest	7.389	.972	3.806	13.167	84.17	11.39
Experiment No. 8, carbohydrate diet, rest	8.460	1.160	3.380	14.000	93.40	11.04
Experiment No. 9, carbohydrate diet, rest	10.680	1.480	6.020	19.180	113.80	10.66
Experiment No. 10, special diet, rest	8.582	1.164	4.673	15.419	92.37	10.76
Experiment No. 11, carbohydrate diet, work	8.944	1.244	4.478	15.666	97.22	10.87
Experiment No. 12, special diet, work	9.660	1.360	3.940	15.960	109.00	11.28
Experiment No. 13, carbohydrate diet, rest	10.121	1.455	2.606	15.182	113.65	11.23
Experiment No. 14, carbohydrate diet, rest	8.676	1.177	3.412	14.265	96.47	11.12
Experiment Nos. 15–17, special diet, rest	9.360	1.300	3.540	15.200	105.60	11.28
Subject A. W. S.						
Experiment Nos. 18–21, special diet, rest	8.700	1.194	3.172	14.066	97.32	11.19
Subject E. O.						
Experiment Nos. 22–23, special diet, rest	9.030	1.294	3.485	14.809	100.74	11.16
Experiment No. 24, carbohydrate diet, rest	8.052	1.154	3.282	13.488	88.98	11.05
Subject J. F. S.						
Experiment No. 25, carbohydrate diet, rest	10.000	1.483	4.621	17.104	114.50	11.45
Experiment No. 26, fat diet, rest	8.576	1.030	4.394	15.000	96.06	11.20
Experiment No. 27, special diet, rest	8.120	.727	4.879	14.726	88.48	10.90
Experiment No. 28, carbohydrate diet, rest	8.081	1.081	3.811	13.973	90.54	11.20
Experiment No. 29, carbohydrate diet, work	9.616	1.385	4.654	16.655	107.30	11.16
Experiment No. 30, special diet, work	9.650	1.350	4.550	16.550	106.00	10.99
Experiment No. 31, fat diet, work	10.125	1.417	4.542	17.084	113.34	11.19
Experiment No. 32, fat diet, work	10.472	1.528	4.667	17.667	118.06	11.27
Experiment No. 33, special diet, work	9.772	1.428	4.657	16.857	107.15	10.97
Experiment No. 34, carbohydrate diet, work	9.914	1.400	4.829	17.143	107.72	10.87
Subject J. C. W.						
Experiment No. 35, carbohydrate diet, rest	8.143	1.163	3.898	14.204	89.80	11.03
Experiment No. 37, carbohydrate diet, work	7.397	1.048	3.635	13.080	80.32	10.86
Experiment No. 38, fat diet, work	11.230	1.646	4.125	18.001	127.50	11.35
Experiment No. 40, carbohydrate diet, work	7.745	1.093	4.198	14.036	84.65	10.93
Experiment No. 41, fat diet, work	13.483	2.017	4.242	20.742	159.50	11.83
Experiment No. 43, fat diet, work	9.672	1.427	3.427	15.526	109.40	11.31
Experiment No. 44, carbohydrate diet, work	6.816	.942	3.719	12.477	73.98	10.85
Experiment No. 45, fat diet, work	10.090	1.455	3.818	16.363	116.38	11.53
Experiment No. 46, fat diet, work	10.488	1.486	3.431	16.405	119.18	11.37
Experiment No. 47, carbohydrate diet, work	6.972	.972	3.635	12.579	74.30	10.66
Experiment No. 48, fat diet, work	12.150	1.750	4.450	19.350	140.00	11.52
Experiment No. 49, carbohydrate diet, work	7.914	1.089	3.936	13.939	82.30	10.40
Experiment No. 50, fat diet, work	9.432	1.381	3.356	15.169	108.49	11.50
Experiment No. 52, fat diet, work	12.619	1.851	3.532	19.002	145.53	11.54
Experiment No. 53, carbohydrate diet, work	8.642	1.200	4.043	14.885	93.42	10.81
Experiment Nos. 54–55, fat diet, work	12.295	1.794	4.059	19.148	142.50	11.59
Average of all experiments	9.229	1.294	3.927	15.450	102.73	11.14

Composition of urine.—Tables 113 and 114 give the results of analysis of the urine in experiments Nos. 35–55, inclusive. The urine was collected in four periods, and the amount, specific gravity, and nitrogen were determined for each period. An aliquot part of the urine for each period was taken to make a composite for the day, and the nitrogen and the heat of combustion were determined for the daily composite. In the same way a composite sample of urine for the entire period of 4, 6, 9, or 10 days was made, and the nitrogen, carbon, hydrogen, water, ash, and heat of combustion were determined in this latter composite. It is assumed that the daily elimination of carbon, hydrogen, and total solids vary directly with the nitrogen, and the calculations are made upon this basis.

The statistics regarding the elementary composition of urine in all the metabolism experiments are given in Tables 115 and 116.

TABLE 113.—*Amount, specific gravity, and nitrogen of urine, by periods, metabolism experiments Nos. 35–55.*

Date.	Period.	Amount.	Specific gravity.	Nitrogen.	
1900.	*Preliminary to experiment No. 35.*	*Grams.*		*Per cent.*	*Grams.*
Dec. 5–6	7 a. m to 7 a. m	786.1	1.0300	1.96	15.41
6–7	7 a. m to 7 a. m	750.9	1.0290	2.05	15.39
7–8	7 a. m to 1 p. m	193.9	1.0290	1.92	3.72
	1 p. m to 7 p. m	193.3	1.0340	2.08	4.02
	7 p .m to 11 p. m	152.9	1.0340	2.00	3.06
	11 p. m to 7 a. m	255.4	1.0295	2.13	5.44
	Total	795.5			16.24
	Total by composite	795.5	1.0315	2.06	16.39
8–9	7 a. m. to 1 p. m	210.2	1.0290	1.96	4.12
	1 p. m. to 7 p. m	240.5	1.0320	1.99	4.79
	7 p. m. to 11 p. m	118.9	1.0315	1.86	2.21
	11 p. m. to 7 a. m	252.7	1.0300	2.21	5.58
	Total	822.3			16.70
	Total by composite	822.3	1.0315	2.02	16.61
	Experiment No. 35.				
9–10	7 a. m. to 1 p. m	230.0	1.0270	1.80	4.14
	1 p. m. to 7 p. m	516.2	1.0165	1.02	5.27
	7 p. m. to 11 p. m	295.5	1.0170	1.05	3.10
	11 p. m to 7 a. m	471.7	1.0135	.99	4.67
	Total	1,513.4			17.18
	Total by composite	1,513.4	1.0180	1.13	17.10
10–11	7 a. m to 1 p. m	252.7	1.0240	1.46	3.69
	1 p. m. to 7 p. m	422.2	1.0170	1.13	4.77
	7 p. m. to 11 p. m	148.5	1.0250	1.51	2.24
	11 p. m. to 7 a. m	416.3	1.0165	1.18	4.91
	Total	1,239.7			15.61
	Total by composite	1,239.7	1.0195	1.26	15.62
11–12	7 a. m. to 1 p. m	284.5	1.0205	1.28	3.64
	1 p. m. to 7 p. m	517.5	1.0155	.88	4.55
	7 p. m. to 11 p. m	252.3	1.0190	1.13	2.85
	11 p. m. to 7 a. m	447.2	1.0145	.97	4.34
	Total	1,501.5			15.38
	Total by composite	1,501.5	1.0170	1.03	15.47

TABLE 113.—*Amount, specific gravity, and nitrogen of urine, by periods*—Continued.

Date.	Period.	Amount.	Specific gravity.	Nitrogen.	
	Experiment No. 35—Continued.	*Grams.*		*Per cent.*	*Grams.*
1900.					
Dec. 12–13	7 a. m. to 1 p. m	257.6	1.0230	1.39	3.58
	1 p. m. to 7 p. m	539.8	1.0145	.86	4.64
	7 p. m. to 11 p. m	140.2	1.0245	1.49	2.09
	11 p. m. to 7 a. m	491.2	1.0140	1.00	4.91
	Total	1,428.8			15.22
	Total by composite	1,428.8	1.0160	1.07	15.29
	Total, 4 days	5,683.4			63.39
	Total by composite	5,683.4	1.0170	1.10	62.52
	Experiment No. 36.				
13–14	7 a. m. to 1 p. m	215.0	1.0250	1.46	3.14
	1 p. m. to 7 p. m	652.9	1.0095	.55	3.59
	7 p. m. to 11 p. m	234.9	1.0120	.75	1.76
	11 p. m. to 7 a. m	297.2	1.0135	1.01	3.00
	Total	1,400.0			11.49
	Total by composite	1,400.0	1.0135	.81	11.34
	Following experiment No. 36.				
14–15	7 a. m. to 1 p. m	179.8	1.0270	1.94	3.49
	1 p. m. to 7 p. m	171.4	1.0320	2.03	3.48
	7 p. m. to 11 p. m	218.3	1.0320	2.03	4.43
	11 p. m. to 7 a. m	330.3	1.0340	2.02	6.67
	Total	899.8			18.07
	Total by composite	899.8	1.0315	2.01	18.09
15–16	7 a. m. to 1 p. m	213.5	1.0320	1.72	3.67
	1 p. m. to 7 p. m	286.3	1.0325	1.41	4.04
	7 p. m. to 11 p. m	170.7	1.0355	1.46	2.49
	11 p. m. to 7 a. m	316.2	1.0290	1.74	5.50
	Total	986.7			15.70
	Total by composite	986.7	1.0320	1.59	15.69
1901.	*Preliminary to experiment No. 37.*				
Jan. 7–8	7 a. m. to 7 a. m	757.5	1.033	1.96	14.85
8–9	7 a. m. to 7 a. m	705.2	1.035	1.92	13.54
9–10	7 a. m. to 1 p. m	159.5	1.032	2.19	3.49
	1 p. m. to 7 p. m	207.9	1.038	1.97	4.10
	7 p. m. to 11 p. m	95.1	1.041	2.39	2.27
	11 p. m. to 7 a. m	195.5	1.035	2.31	4.52
	Total	658.0			14.38
	Total by composite	658.0	1.036	2.18	14.34
10–11	7 a. m. to 1 p. m	232.6	1.030	1.76	4.09
	1 p. m. to 7 p. m	262.8	1.034	1.61	4.23
	7 p. m. to 11 p. m	128.3	1.038	2.17	2.78
	11 p. m. to 7 a. m	309.0	1.023	1.44	4.45
	Total	932.7			15.55
	Total by composite	932.7	1.030	1.67	15.58

TABLE 113.—*Amount, specific gravity, and nitrogen of urine, by periods*—Continued.

Date.	Period.	Amount.	Specific gravity.	Nitrogen.	
1901.	*Experiment No. 37.*	*Grams.*		*Per cent.*	*Grams.*
Jan. 11-12	7 a. to 1 p. m	352.6	1.026	1.21	4.27
	1 p. m. to 7 p. m	639.4	1.019	.65	4.16
	7 p. m. to 11 p. m	173.7	1.030	1.62	2.82
	11 p. m. to 7 a. m	203.8	1.032	1.93	3.93
	Total	1,369.5			15.18
	Total by composite	1,369.5	1.024	1.11	15.20
12-13	7 a. m. to 1 p. m	284.8	1.029	1.31	3.73
	1 p. m. to 7 p. m	309.5	1.031	1.27	3.93
	7 p. m. to 11 p. m	119.9	1.039	2.25	2.70
	11 p. m. to 7 a. m	168.8	1.037	2.54	4.29
	Total	883.0			14.65
	Total by composite	883.0	1.033	1.65	14.57
13-14	7 a. m. to 1 p. m	211.2	1.033	2.02	4.27
	1 p. m. to 7 p. m	292.7	1.034	1.58	4.62
	7 p. m. to 11 p. m	132.1	1.039	2.48	3.28
	11 p. m. to 7 a. m	183.6	1.038	2.67	4.90
	Total	819.6			17.07
	Total by composite	819.6	1.035	2.09	17.13
14-15	7 a. m. to 1 p. m	231.1	1.032	2.21	5.11
	1 p. m. to 7 p. m	319.0	1.032	1.69	5.39
	7 p. m. to 11 p. m	142.2	1.037	2.50	3.55
	11 p. m. to 7 a. m	218.4	1.034	2.45	5.35
	Total	910.7			19.40
	Total by composite	910.7	1.034	2.13	19.40
	Total, 4 days	3,982.8			66.30
	Experiment No. 38.				
15-16	7 a. m to 1 p. m	236.4	1.033	2.10	4.96
	1 p. m. to 7 p. m	334.4	1.034	1.54	5.15
	7 p. m to 11 p. m	146.3	1.037	2.44	3.57
	11 p. m. to 7 a. m	237.3	1.035	2.46	5.84
	Total	954.4			19.52
	Total by composite	954.4	1.033	2.05	19.56
16-17	7 a. m. to 1 p. m	276.0	1.031	1.91	5.27
	1 p. m. to 7 p. m	364.9	1.031	1.47	5.36
	7 p. m. to 11 p. m	163.9	1.037	2.28	3.74
	11 p. m. to 7 a. m	231.5	1.035	2.55	5.90
	Total	1,036.3			20.27
	Total by composite	1,036.3	1.033	1.95	20.21
17-18	7 a. m. to 1 p. m	288.4	1.032	1.84	5.31
	1 p. m. to 7 p. m	368.2	1.031	1.51	5.56
	7 p. m. to 11 p. m	147.3	1.037	2.51	3.70
	11 p. m. to 7 a. m	217.0	1.036	2.66	5.77
	Total	1,020.9			20.34
	Total by composite	1,020.9	1.034	1.99	20.32

TABLE 113.—*Amount, specific gravity, and nitrogen of urine, by periods*—Continued.

Date.	Period.	Amount.	Specific gravity.	Nitrogen.	
1901.	*Experiment No. 38*—Continued.	*Grams.*		*Per cent.*	*Grams.*
Jan. 18–19	7 a. m. to 1 p. m	267.8	1.031	2.01	5.38
	1 p. m. to 7 p. m	363.3	1.032	1.54	5.59
	7 p. m. to 11 p. m	157.8	1.037	2.53	3.99
	11 p. m. to 7 a. m	232.7	1.034	2.58	6.00
	Total	1,021.6			20.96
	Total by composite	1,021.6	1.034	2.05	20.94
	Total, 4 days	4,033.2			81.09
	Experiment No. 39.				
19–20	7 a. m. to 1 p. m	158.9	1.034	2.58	4.10
	1 p. m. to 7 p. m	342.0	1.020	1.26	4.31
	7 p. m. to 11 p. m	429.5	1.014	.66	2.84
	11 p. m. to 7 a. m	380.0	1.019	1.24	4.71
	Total	1,310.4			15.96
	Total by composite	1,310.4	1.018	1.22	15.99
	Total, 9 days	9,326.4			163.35
	Total by composite	9,326.4	1.033	1.75	163.21
	Following experiment No. 39.				
20–21	7 a. m. to 1 p. m	249.0	1.027	2.03	5.05
	1 p. m. to 7 p. m	294.8	1.029	2.03	5.98
	7 p. m. to 11 p. m	184.4	1.033	2.25	4.15
	11 p. m. to 7 a. m	312.9	1.030	2.13	6.66
	Total	1,041.1			21.84
	Total by composite	1,041.1	1.029	2.10	21.86
	Preliminary to experiment No. 40.				
Feb. 22–23	7 a. m. to 7 a. m	827.6	1.0315	1.56	12.91
23–24	7 a. m. to 7 a. m	1,109.5	1.0300	1.53	16.98
24–25	7 a. m. to 1 p. m	220.9	1.0290	1.62	3.58
	1 p. m. to 7 p. m	293.2	1.0305	1.50	4.40
	7 p. m. to 11 p. m	188.6	1.0345	1.88	3.55
	11 p. m. to 7 a. m	247.2	1.0295	1.91	4.72
	Total	949.9			16.25
	Total by composite	949.9	1.0310	1.67	15.85
25–26	7 a. m. to 1 p. m	235.3	1.0290	1.61	3.79
	1 p. m. to 7 p. m	231.8	1.0330	1.86	4.31
	7 p. m. to 11 p. m	146.4	1.0370	2.11	3.09
	11 p. m. to 7 a. m	226.1	1.0310	2.09	4.73
	Total	839.6			15.92
	Total by composite	839.6	1.0320	1.87	15.70
	Experiment No. 40.				
26–27	7 a. m. to 1 p. m	260.2	1.0295	1.53	3.98
	1 p. m. to 7 p. m	312.3	1.0310	1.37	4.28
	7 p. m. to 11 p. m	130.2	1.0415	2.27	2.96
	11 p. m. to 7 a. m	188.9	1.0350	2.46	4.65
	Total	891.6			15.87
	Total by composite	891.6	1.0330	1.79	15.96

TABLE 113.—*Amount, specific gravity, and nitrogen of urine, by periods*—Continued.

Date.	Period.	Amount.	Specific gravity.	Nitrogen.	
1901.	*Experiment No. 40*—Continued.	*Grams.*		*Per cent.*	*Grams.*
Feb. 27–28	7 a. m. to 1 p. m	215.5	1.0320	1.94	4.18
	1 p. m. to 7 p. m	251.4	1.0340	1.72	4.32
	7 p. m. to 11 p. m	117.9	1.0415	2.48	2.92
	11 p. m. to 7 a. m	184.0	1.0365	2.55	4.69
	Total	768.8			16.11
	Total by composite	768.8	1.0345	2.10	16.14
28–Mar. 1.	7 a. m. to 1 p. m	226.2	1.0325	1.96	4.43
	1 p. m. to 7 p. m	291.0	1.0335	1.66	4.83
	7 p. m. to 11 p. m	136.0	1.0400	2.51	3.41
	11 p. m. to 7 a. m	196.2	1.0360	2.53	4.96
	Total	849.4			17.63
	Total by composite	849.4	1.0350	2.08	17.67
Mar. 1–2	7 a. m. to 1 p. m	226.7	1.0315	2.04	4.62
	1 p. m. to 7 p. m	272.5	1.0355	1.78	4.85
	7 p. m. to 11 p. m	128.4	1.0420	2.48	3.18
	11 p. m. to 7 a. m	192.2	1.0360	2.60	5.00
	Total	819.8			17.65
	Total by composite	819.8	1.0350	2.14	17.54
	Total, 4 days	3,329.6			67.26
	Experiment No. 41.				
2–3	7 a. m. to 1 p. m	274.3	1.0290	1.83	5.02
	1 p. m. to 7 p. m	405.2	1.0290	1.30	5.27
	7 p. m. to 11 p. m	166.5	1.0340	2.22	3.70
	11 p. m. to 7 a. m	357.6	1.0250	1.73	6.19
	Total	1,203.6			20.18
	Total by composite	1,203.6	1.0285	1.68	20.22
3–4	7 a. m. to 1 p. m	352.0	1.0235	1.40	4.93
	1 p. m. to 7 p. m	575.9	1.0230	.93	5.37
	7 p. m. to 11 p. m	223.9	1.0275	1.68	3.76
	11 p. m. to 7 a. m	609.0	1.0170	1.04	6.33
	Total	1,760.8			20.39
	Total by composite	1,760.8	1.0215	1.16	20.43
4–5	7 a. m. to 1 p. m	386.8	1.0240	1.24	4.81
	1 p. m. to 7 p. m	565.4	1.0240	.94	5.31
	7 p. m. to 11 p. m	209.5	1.0300	1.79	3.76
	11 p. m. to 7 a. m	572.6	1.0180	1.05	6.01
	Total	1,734.3			19.89
	Total by composite	1,734.3	1.0220	1.15	19.94
5–6	7 a. m. to 1 p. m	364.2	1.0245	1.30	4.73
	1 p. m. to 7 p. m	487.6	1.0275	1.08	5.27
	7 p. m. to 11 p. m	193.6	1.0315	1.97	3.81
	11 p. m. to 7 a. m	510.4	1.0190	1.14	5.82
	Total	1,555.8			19.63
	Total by composite	1,555.8	1.0240	1.27	19.76
	Total, 4 days	6,254.5			80.09

TABLE 113.—*Amount, specific gravity, and nitrogen of urine, by periods*—Continued.

Date.	Period.	Amount.	Specific gravity.	Nitrogen.	
	Experiment No. 42.				
1901.		*Grams.*		*Per cent.*	*Grams.*
Mar. 6-7	7 a. m. to 1 p. m	307.7	1.0210	1.35	4.15
	1 p. m. to 7 p. m	767.9	1.0120	.50	3.84
	7 p. m. to 11 p. m	299.3	1.0155	.76	2.27
	11 p. m. to 7 a. m	369.8	1.0175	1.04	3.85
	Total	1,744.7			14.11
	Total by composite	1,744.7	1.0150	.81	14.13
	Total, 9 days	11,328.8			161.46
	Total by composite	11,328.8	1.0165	1.43	162.00
	Following experiment No. 42.				
7-8	7 a. m. to 1 p. m	268.2	1.0255	1.66	4.45
	1 p. m. to 7 p. m	314.6	1.0275	1.76	5.54
	7 p. m. to 11 p. m	234.3	1.0290	1.80	4.22
	11 p. m. to 7 a. m	303.5	1.0275	1.76	5.34
	Total	1,120.6			19.55
	Total by composite	1,120.6	1.0280	1.74	19.50
	Preliminary to experiment No. 43.				
25-26	7 a. m. to 7 a. m	862.4	1.0345	1.74	15.00
26-27	do	939.7	1.0320	1.90	17.85
27-28	7 a. m. to 1 p. m	169.7	1.0305	1.83	3.11
	1 p. m. to 7 p. m	239.2	1.0310	1.80	4.31
	7 p. m. to 11 p. m	135.9	1.0350	1.97	2.68
	11 p. m. to 7 a. m	285.7	1.0300	1.93	5.51
	Total	830.5			15.61
	Total by composite	830.5	1.0315	1.87	15.53
28-29	7 a. m. to 1 p. m	267.9	1.0280	1.51	4.05
	1 p. m. to 7 p. m	307.7	1.0305	1.56	4.80
	7 p. m. to 11 p. m	218.2	1.0310	1.54	3.36
	11 p. m. to 7 a. m	258.7	1.0300	1.80	4.66
	Total	1,052.5			16.87
	Total by composite	1,052.5	1.0300	1.58	16.63
	Experiment No. 43.				
29-30	7 a. m. to 1 p. m	403.6	1.0250	1.09	4.40
	1 p. m. to 7 p. m	413.3	1.0275	1.10	4.55
	7 p. m. to 11 p. m	211.4	1.0320	1.84	3.89
	11 p. m. to 7 a. m	657.8	1.0170	.89	5.85
	Total	1,686.1			18.69
	Total by composite	1,686.1	1.0225	1.11	18.72
30-31	7 a. m. to 1 p. m	404.2	1.0240	1.20	4.85
	1 p. m. to 7 p. m	491.8	1.0240	1.07	5.26
	7 p. m. to 11 p. m	216.7	1.0280	1.74	3.77
	11 p. m. to 7 a. m	811.0	1.0145	.72	5.84
	Total	1,923.7			19.72
	Total by composite	1,923.7	1.0190	1.01	19.43

TABLE 113.—*Amount, specific gravity, and nitrogen of urine, by periods*—Continued.

Date.	Period.	Amount.	Specific gravity.	Nitrogen.	
1901.	*Experiment No. 43*—Continued.	*Grams.*		*Per cent.*	*Grams.*
Mar. 31–Apr. 1.	7 a. m. to 1 p. m	464.0	1.0220	1.02	4.73
	1 p. m. to 7 p. m	553.3	1.0225	.89	4.92
	7 p. m. to 11 p. m	223.2	1.0270	1.58	3.53
	11 p. m. to 7 a. m	766.1	1.0150	.68	5.21
	Total	2,006.6			18.39
	Total by composite	2,006.6	1.0190	.91	18.26
Apr. 1–2	7 a. m. to 1 p. m	476.0	1.0210	.97	4.62
	1 p. m. to 7 p. m	754.9	1.0170	.65	4.91
	7 p. m. to 11 p. m	217.0	1.0260	1.54	3.34
	11 p. m. to 7 a. m	821.4	1.0135	.65	5.34
	Total	2,269.3			18.21
	Total by composite	2,269.3	1.0165	.79	17.93
	Total, 4 days	7,885.7			75.01
	Experiment No. 44.				
2–3	7 a. m. to 1 p. m	496.8	1.0200	.92	4.57
	1 p. m. to 7 p. m	716.9	1.0170	.65	4.66
	7 p. m. to 11 p. m	184.2	1.0290	1.67	3.08
	11 p. m. to 7 a. m	591.5	1.0145	.81	4.79
	Total	1,989.4			17.10
	Total by composite	1,989.4	1.0175	.87	17.31
3–4	7 a. m. to 1 p. m	595.2	1.0150	.69	4.11
	1 p. m. to 7 p. m	446.5	1.0210	.95	4.24
	7 p. m. to 11 p. m	181.2	1.0285	1.62	2.94
	11 p. m. to 7 a. m	858.7	1.0130	.56	4.81
	Total	2,081.6			16.10
	Total by composite	2,081.6	1.0155	.77	16.03
4–5	7 a. m. to 1 p. m	543.6	1.0170	.77	4.19
	1 p. m. to 7 p. m	616.8	1.0185	.74	4.56
	7 p. m. to 11 p. m	200.0	1.0260	1.55	3.10
	11 p. m. to 7 a. m	898.5	1.0135	.56	5.03
	Total	2,258.9			16.88
	Total by composite	2,258.9	1.0150	.75	16.94
5–6	7 a. m. to 1 p. m	481.4	1.0180	.87	4.19
	1 p. m. to 7 p. m	499.4	1.0210	.94	4.69
	7 p. m. to 11 p. m	203.4	1.0280	1.66	3.38
	11 p. m. to 7 a. m	728.4	1.0140	.73	5.32
	Total	1,912.6			17.58
	Total by composite	1,912.6	1.0180	.90	17.21
	Total, 4 days	8,242.5			67.66
	Experiment No. 45.				
6–7	7 a. m. to 1 p. m	445.2	1.0215	1.04	4.63
	1 p. m. to 7 p. m	671.3	1.0210	.76	5.10
	7 p. m. to 11 p. m	211.4	1.0265	1.62	3.42
	11 p. m. to 7 a. m	906.0	1.0150	.63	5.71
	Total	2,233.9			18.86
	Total by composite	2,233.9	1.0180	.84	18.75
	Total, 9 days	18,362.1			161.53
	9 day composite	18,362.1	1.0190	.87	159.75

TABLE 113.—*Amount, specific gravity, and nitrogen of urine, by periods*—Continued.

Date.	Period.	Amount.	Specific gravity.	Nitrogen.	
				Per cent.	Grams.
1901.	*Following experiment No. 45.*	*Grams.*		*Per cent.*	*Grams.*
Apr. 7–8	7 a. m. to 1 p. m	269.9	1.0255	1.64	4.43
	1 p. m. to 7 p. m	456.2	1.0265	1.28	5.84
	7 p. m. to 11 p. m	316.5	1.0265	1.18	3.73
	11 p. m. to 7 a. m	528.0	1.0240	1.21	6.39
	Total	1,570.6			20.39
	Total by composite	1,570.6	1.0250	1.29	20.26
	Preliminary to experiment No. 46.				
29–30	7 a. m. to 7 a. m	1,853.5	1.0190	.89	16.50
30–May 1	7 a. m. to 7 a. m	1,931.7	1.0190	.79	15.26
May 1–2	7 a. m. to 1 p. m	400.6	1.0235	.91	3.65
	1 p. m. to 7 p. m	367.4	1.0240	.92	3.38
	7 p. m. to 11 p. m	297.2	1.0220	.93	2.76
	11 p. m. to 7 a. m	498.4	1.0200	.95	4.73
	Total	1,563.6			14.52
	Total by composite	1,563.6	1.0225	.93	14.54
2–3	7 a. m. to 1 p. m	775.7	1.0140	.51	3.96
	1 p. m. to 7 p. m	545.3	1.0190	.70	3.82
	7 p. m. to 11 p. m	251.6	1.0225	.86	2.16
	11 p. m. to 7 a. m	396.1	1.0220	.99	3.92
	Total	1,968.7			13.86
	Total by composite	1,968.7	1.0190	.71	13.98
	Experiment No. 46.				
3–4	7 a. m. to 1 p. m	461.7	1.0225	.74	3.42
	1 p. m. to 7 p. m	426.3	1.0270	.78	3.33
	7 p. m. to 11 p. m	148.0	1.0350	1.80	2.66
	11 p. m. to 7 a. m	306.8	1.0270	1.54	4.72
	Total	1,342.8			14.13
	Total by composite	1,342.8	1.0260	1.06	14.23
4–5	7 a. m to 1 p. m	345.3	1.0265	1.10	3.80
	1 p. m. to 7 p. m	392.3	1.0270	1.07	4.20
	7 p. m. to 11 p. m	159.8	1.0350	1.95	3.12
	11 p. m. to 7 a. m	348.7	1.0240	1.47	5.12
	Total	1,246.1			16.24
	Total by composite	1,246.1	1.0270	1.31	16.32
5–6	7 a. m. to 1 p. m	333.6	1.0265	1.29	4.30
	1 p. m. to 7 p. m	408.6	1.0260	.95	3.88
	7 p. m. to 11 p. m	171.0	1.0300	1.83	3.13
	11 p. m. to 7 a. m	334.4	1.0245	1.54	5.15
	Total	1,247.6			16.46
	Total by composite	1,247.6	1.0260	1.34	16.72
6–7	7 a. m. to 1 p. m	432.7	1.0220	.99	4.28
	1 p. m. to 7 p. m	525.2	1.0230	.82	4.31
	7 p. m. to 11 p. m	172.1	1.0320	1.80	3.10
	11 p. m. to 7 a. m	480.1	1.0175	1.05	5.04
	Total	1,610.1			16.73
	Total by composite	1,610.1	1.0215	1.05	16.91
	Total, 4 days	5,446.6			63.56

Table 113.—*Amount, specific gravity, and nitrogen of urine, by periods*—Continued.

Date.	Period.	Amount.	Specific gravity.	Nitrogen.	
	Experiment No. 47.	*Grams.*		*Per cent.*	*Grams.*
1901.					
May 7–8	7 a. m. to 1 p. m	381.7	1.0225	1.06	4.05
	1 p. m. to 7 p. m	460.6	1.0250	.96	4.42
	7 p. m. to 11 p. m	148.0	1.0340	1.92	2.84
	11 p. m. to 7 a. m	649.0	1.0145	.70	4.54
	Total	1,639.3			15.85
	Total by composite	1,639.3	1.0205	.97	15.90
8–9	7 a. m. to 1 p. m	320.9	1.0230	1.21	3.88
	1 p. m. to 7 p. m	401.8	1.0250	1.07	4.30
	7 p. m. to 11 p. m	140.3	1.0340	1.94	2.72
	11 p. m. to 7 a. m	723.3	1.0140	.67	4.85
	Total	1,586.3			15.75
	Total by composite	1,586.3	1.0195	.99	15.70
9–10	7 a. m. to 1 p. m	429.0	1.0200	.94	4.03
	1 p. m. to 7 p. m	424.5	1.0235	1.02	4.33
	7 p. m. to 11 p. m	155.8	1.0315	1.82	2.84
	11 p. m. to 7 a. m	728.4	1.0130	.66	4.81
	Total	1,737.7			16.01
	Total by composite	1,737.7	1.0180	.93	16.16
10–11	7 a. m. to 1 p. m	360.3	1.0230	1.15	4.14
	1 p. m. to 7 p. m	402.3	1.0255	1.11	4.47
	7 p. m. to 11 p. m	155.0	1.0335	1.93	2.99
	11 p. m. to 7 a. m	545.0	1.0165	.94	5.12
	Total	1,462.6			16.72
	Total by composite	1,462.6	1.0210	1.15	16.82
	Total, 4 days	6,425.9			64.33
	Experiment No. 48.				
11–12	7 a. m. to 1 p. m	332.0	1.0265	1.26	4.18
	1 p. m. to 7 p. m	445.6	1.0265	.99	4.41
	7 p. m. to 11 p. m	158.8	1.0340	1.93	3.06
	11 p. m. to 7 a. m	481.5	1.0210	1.15	5.54
	Total	1,417.9			17.19
	Total by composite	1,417.9	1.0250	1.22	17.30
	Total 9 days	13,290.4			145.08
	Total 9 day composite	13,290.4	1.0240	1.09	144.87
	Following experiment No. 48.				
12–13	7 a. m. to 1 p. m	224.8	1.0300	1.81	4.07
	1 p. m. to 7 p. m	411.4	1.0290	1.29	5.31
	7 p. m. to 11 p. m	423.1	1.0290	1.28	5.42
	11 p. m. to 7 a. m	346.2	1.0280	1.72	5.95
	Total	1,405.5			20.75
	Total by composite	1,405.5	1.0290	1.48	20.80
1902.	*Preliminary to experiment No. 49.*				
Mar. 23–24	7 a. m. to 7 a. m	1,268.4	1.0275	1.466	18.59
24–25	7 a. m. to 7 a. m	1,141.0	1.0265	1.336	15.24
	Total				
	Total by composite				

TABLE 113.—*Amount, specific gravity, and nitrogen of urine, by periods*—Continued.

Date.	Period.	Amount.	Specific gravity.	Nitrogen.	
1902.	*Preliminary to experiment No. 49*—Cont'd.	*Grams.*		*Per cent.*	*Grams.*
Mar. 25–26	7 a. m. to 1 p. m	317.1	1.0260	1.223	3.88
	1 p. m. to 7 p. m	288.0	1.0310	1.466	4.22
	7 p. m. to 11 p. m	169.7	1.0335	1.692	2.87
	11 p. m. to 7 a. m	464.1	1.0190	.975	4.52
	Total	1,238.9			15.49
	Total by composite	1,238.9	1.0240	1.245	15.42
26–27	7 a. m. to 1 p. m	225.1	1.0285	1.610	3.62
	1 p. m. to 7 p. m	262.1	1.0330	1.500	3.93
	7 p. m. to 11 p. m	183.9	1.0340	1.445	2.66
	11 p. m. to 7 a. m	283.9	1.0290	1.552	4.41
	Total	955.0			14.62
	Total by composite	955.0	1.0295	1.526	14.57
	Experiment No. 49.				
27–28	7 a. m. to 1 p. m	375.6	1.0240	1.039	3.90
	1 p. m. to 7 p. m	891.7	1.0155	.464	4.14
	7 p. m. to 11 p. m	199.4	1.0260	1.452	2.90
	11 p. m. to 7 a. m	552.1	1.0160	.812	4.48
	Total	2,018.8			15.42
	Total by composite	2,018.8	1.0180	.768	15.50
28–29	7 a. m. to 1 p. m	479.7	1.0190	.861	4.13
	1 p. m. to 7 p. m	549.6	1.0185	.793	4.36
	7 p. m. to 11 p. m	443.2	1.0160	.671	2.97
	11 p. m. to 7 a. m	799.2	1.0120	.542	4.33
	Total	2,271.7			15.79
	Total by composite	2,271.7	1.0165	.698	15.86
29–30	7 a. m. to 1 p. m	751.9	1.0140	.536	4.03
	1 p. m. to 7 p. m	924.6	1.0140	.451	4.17
	7 p. m. to 11 p. m	244.1	1.0220	1.148	2.80
	11 p. m. to 7 a. m	795.3	1.0120	.523	4.16
	Total	2,715.9			15.16
	Total by composite	2,715.9	1.0135	.557	15.13
	Total, 3 days	7,006.4			46.37
	Experiment No. 50.				
30–31	7 a. m. to 1 p. m	520.2	1.0190	.749	3.90
	1 p. m. to 7 p. m	774.9	1.0165	.535	4.15
	7 p. m. to 11 p. m	169.9	1.0250	1.178	2.00
	11 p. m. to 7 a. m	216.7	1.0255	1.596	3.46
	Total	1,681.7			13.51
	Total by composite	1,681.7	1.0220	.804	13.52
	Experiment No. 51.				
31–Apr. 1	7 a. m. to 1 p. m	323.8	1.0195	.962	3.12
	1 p. m. to 7 p. m	294.4	1.0245	1.083	3.19
	7 p. m. to 11 p. m	144.2	1.0250	1.254	1.81
	11 p. m. to 7 a. m	255.0	1.0230	1.417	3.61
	Total	1,017.4			11.73
	Total by composite	1,017.4	1.0230	1.162	11.82

TABLE 113.—*Amount, specific gravity, and nitrogen of urine, by periods*—Continued.

Date.	Period.	Amount.	Specific gravity.	Nitrogen.	
1902.	*Experiment No. 51*—Continued.	*Grams.*		*Per cent.*	*Grams.*
Apr. 1–2	7 a. m. to 1 p. m	170.2	1.0270	1.677	2.85
	1 p. m. to 7 p. m	185.6	1.0320	1.719	3.19
	7 p. m. to 11 p. m	177.2	1.0270	1.451	2.57
	11 p. m. to 7 a. m	245.1	1.0290	1.885	4.62
	Total	778.1			13.23
	Total by composite	778.1	1.0290	1.706	13.27
	Total, 2 days	1,795.5			24.96
	Total, 6 days	10,483.6			84.84
	Total by composite	10,483.6	1.0190	.796	83.45
	Following experiment No. 51.				
2–3	7 a. m. to 1 p. m	223.2	1.0270	2.037	4.55
	1 p. m. to 7 p. m	217.7	1.0290	2.065	4.49
	7 p. m. to 11 p. m	202.1	1.0290	1.945	3.93
	11 p. m. to 7 a. m	423.3	1.0240	1.517	6.42
	Total	1,066.3			19.39
	Total by composite	1,066.3	1.0270	1.815	19.35
3–4	7 a. m. to 7 a. m	1,262.5	1.0250	1.085	13.70
	Preliminary to experiment No. 52.				
17–18	7 a. m. to 7 a. m	880.1	1.0250	1.698	14.94
18–19	7 a. m. to 7 a. m	1,094.6	1.0250	1.765	19.32
	Total				
	Total by composite				
19–20	7 a. m. to 1 p. m	171.2	1.0250	1.861	3.19
	1 p. m. to 7 p. m	252.3	1.0250	1.632	4.12
	7 p. m. to 11 p. m	130.2	1.0295	1.830	2.38
	11 p. m. to 7 a. m	386.4	1.0190	1.491	5.76
	Total	940.1			15.45
	Total by composite	940.1	1.0255	1.674	15.74
20–21	7 a. m. to 1 p. m	185.1	1.0235	1.551	2.87
	1 p. m. to 7 p. m	328.4	1.0205	1.427	4.69
	7 p. m. to 11 p. m	243.8	1.0165	1.174	2.86
	11 p. m. to 7 a. m	271.0	1.0230	1.518	4.11
	Total	1,028.3			14.53
	Total by composite	1,028.3	1.0200	1.375	14.14
	Experiment No. 52.				
21–22	7 a. m. to 1 p. m	780.5	1.0115	.525	4.10
	1 p. m. to 7 p. m	823.7	1.0130	.467	3.85
	7 p. m. to 11 p. m	218.3	1.0205	1.362	2.97
	11 p. m. to 7 a. m	305.6	1.0215	1.454	4.44
	Total	2,128.1			15.36
	Total by composite	2,128.1	1.0135	.712	15.15
22–23	7 a. m. to 1 p. m	337.6	1.0200	1.200	4.05
	1 p. m. to 7 p. m	386.2	1.0210	1.153	4.45
	7 p. m. to 11 p. m	156.6	1.0260	1.945	3.05
	11 p. m. to 7 a. m	528.4	1.0130	.925	4.89
	Total	1,408.8			16.44
	Total by composite	1,408.8	1.0215	1.162	16.37

TABLE 113.—*Amount, specific gravity, and nitrogen of urine, by periods*—Continued.

Date.	Period.	Amount.	Specific gravity.	Nitrogen.	
1902.	*Experiment No. 52*—Continued.	*Grams.*		*Per cent.*	*Grams.*
Apr. 23–24	7 a. m. to 1 p. m	666.3	1.0110	0.664	4.42
	1 p. m. to 7 p. m	656.5	1.0130	.643	4.22
	7 p. m. to 11 p. m	194.3	1.0215	1.579	3.07
	11 p. m. to 7 a. m	367.5	1.0160	1.210	4.45
	Total	1,884.6			16.16
	Total by composite	1,884.6	1.0145	.862	16.25
	Total, 3 days	5,421.5			47.96
	Experiment No. 53.				
24–25	7 a. m. to 1 p. m	307.5	1.0200	1.364	4.19
	1 p. m. to 7 p. m	334.5	1.0210	1.066	3.57
	7 p. m. to 11 p. m	126.5	1.0290	1.928	2.44
	11 p. m. to 7 a. m	230.1	1.0250	1.736	3.99
	Total	998.6			14.19
	Total by composite	998.6	1.0250	1.428	14.26
25–26	7 a. m. to 1 p. m	265.0	1.0260	1.414	3.75
	1 p. m. to 7 p. m	352.2	1.0230	1.157	4.07
	7 p. m. to 11 p. m	137.3	1.0295	1.931	2.65
	11 p. m. to 7 a. m	416.9	1.0140	1.008	4.20
	Total	1,171.4			14.67
	Total by composite	1,171.4	1,0210	1.258	14.74
26–27	7 a. m. to 1 p. m	303.0	1.0215	1.300	3.94
	1 p. m. to 7 p. m	511.4	1.0190	.888	4.54
	7 p. m. to 11 p. m	189.6	1.0230	1.511	2.86
	11 p. m. to 7 a. m	447.4	1.0150	.987	4.42
	Total	1,451.4			15.76
	Total by composite	1,451.4	1.0180	1.080	15.68
	Total, 3 days	3,621.4			44.62
	Experiment No. 54.				
27–28	7 a. m. to 1 p. m	676.6	1.0120	.625	4.23
	1 p. m. to 7 p. m	996.6	1.0100	.400	3.99
	7 p. m. to 11 p. m	303.1	1.0170	1.143	3.46
	11 p. m. to 7 a. m	425.5	1.0150	1.074	4.57
	Total	2,401.8			16.25
	Total by composite	2,401.8	1.0125	.676	16.24
28–29	7 a. m. to 1 p. m	484.5	1.0145	.920	4.46
	1 p. m. to 7 p. m	949.4	1.0110	.484	4.60
	7 p. m. to 11 p. m	224.9	1.0200	1.428	3.21
	11 p. m. to 7 a. m	348.5	1.0190	1.342	4.68
	Total	2,007.3			16.95
	Total by composite	2,007.3	1.0150	.846	16.98
29–30	7 a. m. to 1 p. m	644.5	1.0140	.683	4.40
	1 p. m. to 7 p. m	769.0	1.0130	.592	4.55
	7 p. m. to 11 p. m	196.2	1.0235	1.578	3.10
	11 p. m. to 7 a. m	445.5	1.0150	1.026	4.57
	Total	2,055.2			16.62
	Total by composite	2,055.2	1.0140	.807	16.59
	Total, 3 days	6,464.3			49.82

TABLE 113.—*Amount, specific gravity, and nitrogen of urine, by periods*—Continued.

Date.	Period.	Amount.	Specific gravity.	Nitrogen.	
1902.	*Experiment No. 55.*	*Grams.*		*Per cent.*	*Grams.*
Apr. 30–May 1	7 a. m. to 1 p. m	298.0	1.0225	1.338	3.99
	1 p. m. to 7 p. m	330.0	1.0270	1.326	4.38
	7 p. m. to 11 p. m	200.6	1.0290	1.623	3.26
	11 p. m. to 7 a. m	340.2	1.0310	1.688	5.74
	Total	1,168.8			17.37
	Total by composite	1,168.8	1.0290	1.478	17.27
	Total, 10 days	16,676.0			159.77
	Ten-day composite	16,676.0	1.0170	.956	159.42
	Following experiment No. 55.				
May 1–2	7 a. m. to 1 p. m	270.8	1.0280	2.027	5.49
	1 p. m. to 7 p. m	300.2	1.0300	2.313	6.94
	7 p. m. to 11 p. m	126.2	1.0320	2.379	3.00
	11 p. m. to 7 a. m	247.5	1.0330	2.518	6.23
	Total	944.7			21.66
	Total by composite	944.7	1.0305	2.286	21.60
2–3	7 a. m. to 1 p. m	237.8	1.0280	2.274	5.41
	1 p. m. to 7 p. m	236.4	1.0305	2.159	5.10
	7 p. m. to 11 p. m	210.1	1.0310	2.150	4.52
	11 p. m. to 7 a. m	310.4	1.0310	1.912	5.93
	Total	994.7			20.96
	Total by composite	994.7	1.0300	2.098	20.87

TABLE 114.—*Percentage composition of urine, metabolism experiments Nos. 35–55.*

Experiment No.	Date.	Water.	Total solids.	Nitrogen.	Carbon.	Hydrogen.	Ash.	Heat of combustion per gram.
	1900.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Calories.*
35	Dec. 9–10			1.13				0.094
35	10–11			1.26				.107
35	11–12			1.03				.088
35	12–13			1.07				.093
35	4-day composite	95.99	4.01	1.10	0.83	0.21	0.44	.093
36	Dec. 13–14	96.94	3.06	.81	.61	.15	.44	.068
	1901.							
37	Jan. 11–12			1.10				.095
37	12–13			1.65				.118
37	13–14			2.09				.174
37	14–15			2.13				.169
38	15–16			2.05				.160
38	16–17			1.95				.151
38	17–18			1.99				.153
38	18–19			2.05				.152
39	19–20			1.22				.100
37–39	9-day composite	93.56	6.44	1.75	1.34	.34	.80	.156
40	Feb. 26–27			1.79				.146
40	27–28			2.10				.175
40	28–Mar. 1			2.08				.195

TABLE 114.—*Percentage composition of urine, etc.*—Continued.

Experiment No.	Date.	Water.	Total solids.	Nitrogen.	Carbon.	Hydrogen.	Ash.	Heat of combustion per gram.
	1901.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Calories.*
40	Mar. 1–2	....	....	2.14	....	....	....	0.173
41	2–3	....	....	1.68	....	....	....	.128
41	3–4	....	....	1.16	....	....	....	.088
41	4–5	....	....	1.15	....	....	....	.096
41	5–6	....	....	1.27	....	....	....	.100
42	6–7	....	....	.81	....	....	....	.062
40–42	9-day composite	94.69	5.31	1.43	1.04	0.28	0.72	.120
43	Mar. 29–30	....	....	1.11	....	....	....	.089
43	30–31	....	....	1.01	....	....	....	.081
43	31–Apr. 1	....	....	.91	....	....	....	.072
43	Apr. 1–2	....	....	.79	....	....	....	.061
44	2–3	....	....	.87	....	....	....	.070
44	3–4	....	....	.77	....	....	....	.066
44	4–5	....	....	.75	....	....	....	.063
44	5–6	....	....	.90	....	....	....	.074
45	6–7	....	....	.84	....	....	....	.067
43–45	9-day composite	96.69	3.31	.87	.64	.17	.68	.074
46	May 3–4	....	....	1.06	....	....	....	.113
46	4–5	....	....	1.31	....	....	....	.107
46	5–6	....	....	1.34	....	....	....	.126
46	6–7	....	....	1.05	....	....	....	.083
47	7–8	....	....	.97	....	....	....	.082
47	8–9	....	....	.99	....	....	....	.096
47	9–10	....	....	.93	....	....	....	.087
47	10–11	....	....	1.15	....	....	....	.096
48	11–12	....	....	1.22	....	....	....	.114
46–48	9-day composite	95.59	4.41	1.09	.84	.24	.62	.094
	1902.							
49	Mar. 27–28	....	....	.77	....	....	....	.067
49	28–29	....	....	.70	....	....	....	.059
49	29–30	....	....	.56	....	....	....	.050
50	30–31	....	....	.80	....	....	....	.070
51	31–Apr. 1	....	....	1.16	....	....	....	.095
51	Apr. 1–2	....	....	1.71	....	....	....	.137
49–51	6-day composite	96.64	3.36	.80	.64	.18	.56	.074
52	Apr. 21–22	....	....	.71	....	....	....	.058
52	22–23	....	....	1.16	....	....	....	.094
52	23–24	....	....	.86	....	....	....	.068
53	24–25	....	....	1.43	....	....	....	.119
53	25–26	....	....	1.26	....	....	....	.104
53	26–27	....	....	1.08	....	....	....	.098
54	27–28	....	....	.68	....	....	....	.052
54	28–29	....	....	.85	....	....	....	.063
54	29–30	....	....	.81	....	....	....	.070
55	30–May 1	....	....	1.48	....	....	....	.124
52–55	10-day composite	96.07	3.93	.96	.72	.22	.82	.083

TABLE 115.—*Percentage composition of water-free substance of urine in metabolism experiments Nos. 5–55.*

Subject and kind of experiment.	Duration.	In total dry matter.					In organic matter.			
		Nitrogen.	Carbon.	Hydrogen.	Oxygen (by difference).	Ash.	Nitrogen.	Carbon.	Hydrogen.	Oxygen (by difference).
Subject E. O.	*Days.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
Experiment No. 5, rest	4	25.06	16.14	5.06	23.68	30.06	35.83	23.08	7.23	33.86
Experiment No. 6, work	4	22.93	17.57	5.40	26.21	27.89	31.80	24.36	7.49	36.35
Experiment No. 7, rest	4	25.93	19.42	5.28	23.47	25.90	34.99	26.21	7.13	31.67
Experiment No. 8, rest	4	24.65	17.58	4.98	25.31	27.49	34.00	24.24	6.87	34.89
Experiment No. 9, rest	4	26.43	18.03	4.81	25.23	25.50	35.48	24.20	6.46	33.86
Experiment No. 10, rest	4	28.89	20.05	4.77	27.62	18.67	35.52	24.65	5.87	33.96
Experiment No. 11, work	4	26.39	18.75	5.40	26.90	22.56	34.08	24.21	6.97	34.74
Experiment No. 12, work	4	26.26	17.96	4.92	28.93	21.93	33.64	23.01	6.30	37.05
Experiment No. 13, rest	3	24.59	19.08	5.40	26.42	24.51	32.57	25.28	7.15	35.00
Experiment No. 14, rest	4	26.78	20.10	5.74	27.82	19.56	33.29	24.99	7.14	34.58
Experiment Nos. 15–17, rest	6	26.55	18.73	5.26	27.02	22.44	34.23	24.15	6.78	34.84
Subject A. W. S.										
Experiment Nos. 18–20, rest	6	27.65	17.56	5.64	27.62	21.53	35.23	22.38	7.19	35.20
Experiment No. 21, rest	3	27.31	19.11	5.44	28.18	19.96	34.12	23.88	6.79	35.21
Subject E. O.										
Experiment Nos. 22–24, rest	9	28.86	18.59	5.45	26.95	20.15	36.14	23.28	6.83	33.75
Subject J. F. S.										
Experiment No. 25, rest	3	26.48	20.74	5.02	28.49	19.27	32.80	25.69	6.22	35.29
Experiment Nos. 26–28, rest	9	28.09	20.15	4.85	25.47	21.44	35.76	25.65	6.17	32.42
Experiment Nos. 29–31, work	9	28.29	20.00	5.31	25.52	20.88	35.76	25.28	6.71	32.25
Experiment Nos. 32–34, work	9	27.44	19.59	5.41	25.35	22.21	35.28	25.18	6.95	32.59
Subject J. C. W.										
Experiment No. 35, rest	4	27.82	20.70	5.23	35.33	10.92	31.23	23.24	5.87	39.66
Experiment Nos. 37–38, work	8	27.20	20.81	5.28	34.22	12.49	31.08	23.78	6.03	39.11
Experiment Nos. 40–41, work	8	26.83	19.59	5.27	34.74	13.57	31.04	22.67	6.10	40.19
Experiment Nos. 43–45, work	9	26.57	19.33	5.14	28.44	20.52	33.43	24.32	6.47	35.78
Experiment Nos. 46–48, work	9	24.75	19.05	5.44	36.70	14.06	28.80	22.17	6.33	42.70
Experiment Nos. 49–50, work	4	24.08	19.05	5.36	34.84	16.67	28.90	22.86	6.43	41.81
Experiment Nos. 52–55, work	10	24.38	18.32	5.60	30.83	20.87	30.81	23.15	7.08	38.96
Average of all experiments	145	......	......	......	......	......	33.39	24.00	6.64	35.97

TABLE 116.—*Amounts of carbon, oxygen, and hydrogen, total organic matter and energy, corresponding to 1 gram of nitrogen in urine, metabolism experiments Nos. 5–55.*

Subject and kind of experiment.	Duration.	Amounts per gram of nitrogen.					Energy per gram of organic matter.
		Carbon.	Hydrogen.	Oxygen (by difference).	Organic matter.	Energy.	
Subject E. O.	*Days.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Calories.*	*Calories.*
Experiment No. 5, rest	4	0.644	0.202	0.944	2.790	7.087	2.540
Experiment No. 6, work	4	.766	.236	1.143	3.145	7.694	2.446
Experiment No. 7, rest	4	.749	.204	.905	2.858	7.612	2.663
Experiment No. 8, rest	4	.713	.202	1.027	2.942	7.818	2.658
Experiment No. 9, rest	4	.682	.182	.954	2.818	8.063	2.860
Experiment No. 10, rest	4	.694	.165	.956	2.815	7.575	2.691
Experiment No. 11, work	4	.711	.204	1.019	2.934	7.458	2.542
Experiment No. 12, work	4	.684	.187	1.101	2.972	7.251	2.439
Experiment No. 13, rest	3	.776	.220	1.074	3.070	8.848	2.882
Experiment No. 14, rest	4	.751	.214	1.039	3.004	8.755	2.914
Experiment Nos. 15–17, rest	6	.705	.198	1.018	2.921	8.163	2.795
Subject A. W. S.							
Experiment Nos. 18–20, rest	6	.635	.204	.999	2.838	7.486	2.637
Experiment No. 21, rest	3	.700	.199	1.032	2.931	8.204	2.798
Subject E. O.							
Experiment Nos. 22–24, rest	9	.644	.189	.934	2.767	7.439	2.689
Subject J. F. S.							
Experiment No. 25, rest	3	.783	.190	1.076	3.049	8.934	2.932
Experiment Nos. 26–28, rest	9	.717	.173	.907	2.797	8.218	2.938
Experiment Nos. 29–31, work	9	.707	.188	.902	2.797	8.356	2.987
Experiment Nos. 32–34, work	9	.714	.197	.924	2.835	7.711	2.720
Subject J. C. W.							
Experiment No. 35, rest	4	.744	.188	1.271	3.203	8.481	2.648
Experiment Nos. 37–38, work	8	.765	.196	1.258	3.217	7.853	2.441
Experiment Nos. 40–41, work	8	.730	.196	1.294	3.220	8.125	2.523
Experiment Nos. 43–45, work	9	.728	.193	1.070	2.991	8.036	2.687
Experiment Nos. 46–48, work	9	.769	.220	1.483	3.472	9.079	2.615
Experiment Nos. 49–50, work	4	.791	.223	1.446	3.460	8.569	2.477
Experiment Nos. 52–55, work	10	.751	.230	1.265	3.246	8.175	2.518
All subjects.							
Average of 22 experiments, rest	67	.701	.194	.994	2.888	7.974	2.761
Average of 25 experiments, work	78	.738	.205	1.171	3.114	8.104	2.610
Average of 47 experiments, all	145	.721	.200	1.089	3.010	8.065	2.680

RESPIRATORY PRODUCTS.

The determinations of carbon dioxid and water in the ventilating air current in these experiments are given in Tables 117–121, which follow. All determinations were made by two-hour periods; the headings at the top of the columns in Table 118 show how the calculations were made. Table 117 shows the amounts of carbon dioxid and water remaining in the chamber at the beginning and end of each period.

TABLE 117.—*Comparison of residual amounts of carbon dioxid and water in the chamber at the beginning and end of each period and the corresponding gain or loss, metabolism experiments Nos. 35–55, inclusive.*

Date.	End of period.	Carbon dioxid. Total amount in chamber.	Carbon dioxid. Gain (+) or loss (−) over preceding period.	Water. Total amount of vapor remaining in chamber.	Water. Gain (+) or loss (−) over preceding period.	Water. Change in weight of absorbers. Gain (+) or loss (−).	Water. Amount absorbed by underclothes.	Water. Total amount gained (+) or lost (−) during the period.
	Preliminary to experiment No. 35.							
1900.		*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
Dec. 8–9	7 p. m	34.4		44.2				
	9 p. m	36.7	+ 2.3	46.5	+2.3			+2.3
	11 p. m	37.3	+ .6	45.5	−1.0			−1.0
	1 a. m	32.9	− 4.4	46.5	+1.0			+1.0
	3 a. m	24.8	− 8.1	44.8	−1.7			−1.7
	5 a. m	26.2	+ 1.4	43.9	− .9			− .9
	7 a. m	26.7	+ .5	37.8	−6.1			−6.1
	Total		− 7.7		−6.4			−6.4
	Experiment No. 35.							
9–10	9 a. m	38.3	+11.6	45.3	+7.5			+7.5
	11 a. m	38.8	+ .5	43.9	−1.4			−1.4
	1 p. m	35.0	− 3.8	41.1	−2.8			−2.8
	3 p. m	44.8	+ 9.8	44.5	+3.4			+3.4
	5 p. m	35.5	− 9.3	41.9	−2.6			−2.6
	7 p. m	38.8	+ 3.3	42.4	+ .5			+ .5
	9 p. m	38.2	− .6	42.9	+ .5			+ .5
	11 p. m	37.0	− 1.2	40.9	−2.0			−2.0
	1 a. m	27.6	− 9.4	38.1	−2.8			−2.8
	3 a. m	26.9	− .7	38.3	+ .2			+ .2
	5 a. m	25.1	− 1.8	35.0	−3.3			−3.3
	7 a. m	24.6	− .5	35.2	+ .2			+ .2
	Total		− 2.1		−2.6			−2.6
10–11	9 a. m	39.9	+15.3	40.9	+5.7			+5.7
	11 a. m	35.2	− 4.7	35.7	−5.2			−5.2
	1 p. m	32.8	− 2.4	36.2	+ .5			+ .5
	3 p. m	48.9	+16.1	43.7	+7.5			+7.5
	5 p. m	37.2	−11.7	39.6	−4.1			−4.1
	7 p. m	36.2	− 1.0	39.0	− .6			− .6
	9 p. m	31.1	− 5.1	36.0	−3.0			−3.0
	11 p. m	36.4	+ 5.3	36.5	+ .5			+ .5
	1 a. m	31.3	− 5.1	36.7	+ .2			+ .2
	3 a. m	27.9	− 3.4	35.5	−1.2			−1.2
	5 a. m	25.4	− 2.5	32.9	−2.6			−2.6
	7 a. m	25.8	+ .4	34.2	+1.3			+1.3
	Total		+ 1.2		−1.0			−1.0

TABLE 117.—*Comparison of residual amounts of carbon dioxid and water in the chamber at the beginning and end of each period, etc.*—Continued.

Date.	End of period.	Carbon dioxid. Total amount in chamber.	Carbon dioxid. Gain (+) or loss (−) over preceding period.	Water. Total amount of vapor remaining in chamber.	Water. Gain (+) or loss (−) over preceding period.	Water. Change in weight of absorbers. Gain (+) or loss (−).	Water. Amount absorbed by underclothes.	Water. Total amount gained (+) or lost (−) during the period.
	Experiment No. 35—Continued.							
1900.		*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
Dec. 11–12...	9 a. m.	40.4	+14.6	39.9	+5.7	....	....	+5.7
	11 a. m.	37.2	− 3.2	37.0	−2.9	....	....	−2.9
	1 p. m.	32.9	− 4.3	35.2	−1.8	....	....	−1.8
	3 p. m.	50.5	+17.6	39.8	+4.6	....	....	+4.6
	5 p. m.	36.7	−13.8	38.5	−1.3	....	....	−1.3
	7 p. m.	41.1	+ 4.4	39.8	+1.3	....	....	+1.3
	9 p. m.	39.9	− 1.2	39.5	− .3	....	....	− .3
	11 p. m.	36.5	− 3.4	36.4	−3.1	....	....	−3.1
	1 a. m.	27.2	− 9.3	35.7	− .7	....	....	− .7
	3 a. m.	24.8	− 2.4	34.1	−1.6	....	....	−1.6
	5 a. m.	25.8	+ 1.0	35.5	+1.4	....	....	+1.4
	7 a. m.	27.6	+ 1.8	37.0	+1.5	....	....	+1.5
	Total	....	+ 1.8	....	+2.8	....	....	+2.8
12–13...	9 a. m.	41.2	+13.6	38.5	+1.5	....	....	+1.5
	11 a. m.	42.6	+ 1.4	39.0	+ .5	....	....	+ .5
	1 p. m.	36.4	− 6.2	37.8	−1.2	....	....	−1.2
	3 p. m.	42.6	+ 6.2	39.4	+1.6	....	....	+1.6
	5 p. m.	39.1	− 3.5	38.3	−1.1	....	....	−1.1
	7 p. m.	36.2	− 2.9	38.3	0.0	....	....	0.0
	9 p. m.	32.6	− 3.6	35.9	−2.4	....	....	−2.4
	11 p. m.	34.2	+ 1.6	35.9	0.0	....	....	0.0
	1 a. m.	29.5	− 4.7	35.9	0.0	....	....	0.0
	3 a. m.	28.9	− .6	35.0	− .9	....	....	− .9
	5 a. m.	27.1	− 1.8	33.6	−1.4	....	....	−1.4
	7 a. m.	28.0	+ .9	35.5	+1.9	....	....	+1.9
	Total, 1 day	....	+ .4	....	−1.5	....	....	−1.5
	Total, 4 days	....	+ 1.3	....	−2.3	....	....	−2.3
	Experiment No. 36.							
13–14...	9 a. m.	33.9	+ 5.9	35.7	+ .2	....	....	+ .2
	11 a. m.	35.4	+ 1.5	33.7	−2.0	....	....	−2.0
	1 p. m.	32.6	− 2.8	33.1	− .6	....	....	− .6
	3 p. m.	36.4	+ 3.8	34.4	+1.3	....	....	+1.3
	5 p. m.	33.3	− 3.1	33.3	−1.1	....	....	−1.1
	7 p. m.	32.1	− 1.2	34.2	+ .9	....	....	+ .9
	9 p. m.	31.3	− .8	33.6	− .6	....	....	− .6
	11 p. m.	32.4	+ 1.1	33.6	0.0	....	....	0.0
	1 a. m.	25.1	− 7.3	33.6	0.0	....	....	0.0
	3 a. m.	24.6	− .5	32.4	−1.2	....	....	−1.2
	5 a. m.	23.6	− 1.0	32.0	− .4	....	....	− .4
	7 a. m.	32.3	+ 8.7	34.4	+2.4	....	....	+2.4
	Total	....	+ 4.3	....	−1.1	....	....	−1.1

TABLE 117.—*Comparison of residual amounts of carbon dioxid and water in the chamber at the beginning and end of each period, etc.*—Continued.

Date.	End of period.	Carbon dioxid. Total amount in chamber.	Carbon dioxid. Gain (+) or loss (−) over preceding period.	Water. Total amount of vapor remaining in chamber.	Water. Gain (+) or loss (−) over preceding period.	Water. Change in weight of absorbers. Gain (+) or loss (−).	Water. Amount absorbed by underclothes.	Water. Total amount gained (+) or lost (−) during the period.
1901.	*Preliminary to experiment No. 37.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
Jan. 10–11...	7 p. m	72.2	....	41.9	....	....	....	....
	9 p. m	42.5	−29.7	43.4	+ 1.5	....	....	+ 1.5
	11 p. m	43.5	+ 1.0	41.1	− 2.3	....	....	− 2.3
	1 a. m	29.0	−14.5	38.8	− 2.3	....	....	− 2.3
	3 a. m	27.1	− 1.9	39.8	+ 1.0	....	....	+ 1.0
	5 a. m	24.1	− 3.0	40.1	+ .3	....	....	+ .3
	7 a. m	27.6	+ 3.5	41.4	+ 1.3	....	....	+ 1.3
	Total	....	−44.6	....	− 1.8	....	....	− .5
	Experiment No. 37.							
11–12...	9 a. m	93.9	+66.3	53.0	+11.6	+ 107	8	+ 126.6
	11 a. m	103.2	+ 9.3	55.9	+ 2.9	+ 418	8	+ 428.9
	1 p. m	81.2	−22.0	50.9	− 5.0	+ 225	8	+ 228.0
	3 p. m	89.7	+ 8.5	54.1	+ 3.2	+ 85	8	+ 96.2
	5 p. m	127.3	+37.6	60.6	+ 6.5	+ 277	8	+ 291.5
	7 p. m	83.6	−43.7	56.9	− 3.7	+ 211	9	+ 216.3
	9 p. m	54.3	−29.3	52.3	− 4.6	+ 28	....	+ 23.4
	11 p. m	47.3	− 7.0	48.3	− 4.0	0	....	− 4.0
	1 a. m	29.8	−17.5	50.4	+ 2.1	− 30	....	− 27.9
	3 a. m	27.2	− 2.6	50.7	+ .3	− 30	....	− 29.7
	5 a. m	25.8	− 1.4	47.4	− 3.3	− 29	....	− 32.3
	7 a. m	27.6	+ 1.8	48.9	+ 1.5	− 29	....	− 27.5
	Total	....	....	....	+ 7.5	+1,233	49	+1,289.5
12–13...	9 a. m	100.7	+73.1	57.4	+ 8.5	+ 142	10	+ 160.5
	11 a. m	125.0	+24.3	60.6	+ 3.2	+ 340	10	+ 353.2
	1 p. m	101.5	−23.5	57.5	− 3.1	+ 379	10	+ 385.9
	3 p. m	124.9	+23.4	57.9	+ .4	+ 241	10	+ 251.4
	5 p. m	136.8	+11.9	59.5	+ 1.6	+ 397	10	+ 408.6
	7 p. m	97.5	−39.3	58.8	− .7	+ 296	9	+ 304.3
	9 p. m	52.7	−44.8	50.5	− 8.3	+ 21	....	+ 12.7
	11 p. m	43.7	− 9.0	48.7	− 1.8	+ 14	....	+ 12.2
	1 a. m	29.0	−14.7	49.9	+ 1.2	− 32	....	− 30.8
	3 a. m	24.8	− 4.2	47.1	− 2.8	− 32	....	− 34.8
	5 a. m	24.5	− .3	45.6	− 1.5	− 31	....	− 32.5
	7 a. m	26.2	+ 1.7	48.7	+ 3.1	− 31	....	− 27.9
	Total	....	− 1.4	....	− .2	+1,704	59	+1,762.8
13–14...	9 a. m	99.4	+73.2	54.0	+ 5.3	+ 149	8	+ 162.3
	11 a. m	138.6	+39.2	45.8	− 8.2	+ 347	8	+ 346.8
	1 p. m	106.3	−32.3	52.6	+ 6.8	+ 364	8	+ 378.8
	3 p. m	112.5	+ 6.2	57.7	+ 5.1	+ 192	8	+ 205.1
	5 p. m	110.8	− 1.7	57.9	+ .2	+ 396	8	+ 404.2
	7 p. m	90.0	−20.8	58.2	+ .3	+ 229	7	+ 236.3
	9 p. m	43.4	−46.6	49.7	− 8.5	+ 7	....	− 1.5
	11 p. m	41.6	− 1.8	50.7	+ 1.0	− 14	....	− 13.0
	1 a. m	26.2	−15.4	50.9	+ .2	− 34	....	− 33.8

TABLE 117.—*Comparison of residual amounts of carbon dioxid and water in the chamber at the beginning and end of each period, etc.*—Continued.

Date.	End of period.	Carbon dioxid. Total amount in chamber.	Carbon dioxid. Gain (+) or loss (−) over preceding period.	Water. Total amount of vapor remaining in chamber.	Water. Gain (+) or loss (−) over preceding period.	Water. Change in weight of absorbers. Gain (+) or loss (−).	Water. Amount absorbed by underclothes.	Water. Total amount gained (+) or lost (−) during the period.
1901.	*Experiment No. 37*—Continued.	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
Jan. 13–14...	3 a. m	24.9	− 1.3	49.2	− 1.7	− 33	....	− 34.7
	5 a. m	23.6	− 1.3	47.4	− 1.8	− 33	....	− 34.8
	7 a. m	24.5	+ .9	46.1	− 1.3	− 33	....	− 34.3
	Total	....	− 1.7	....	− 2.6	+1,537	47	+1,581.4
14–15...	9 a. m	88.0	+63.5	51.3	+ 5.2	+ 78	5	+ 88.2
	11 a. m	114.1	+26.1	52.6	+ 1.3	+ 283	5	+ 289.3
	1 p. m	89.3	−24.8	52.8	+ .2	+ 229	5	+ 234.2
	3 p. m	103.0	+13.7	56.4	+ 3.6	+ 135	5	+ 143.6
	5 p. m	106.0	+ 3.0	55.4	− 1.0	+ 283	5	+ 287.0
	7 p. m	81.5	−24.5	51.7	− 3.7	+ 198	5	+ 199.3
	9 p. m	44.0	−37.5	47.4	− 4.3	+ 7	....	+ 2.7
	11 p. m	38.8	− 5.2	45.2	− 2.2	0	....	− 2.2
	1 a. m	25.9	−12.9	51.2	+ 6.0	− 32	....	− 26.0
	3 a. m	25.4	− .5	47.6	− 3.6	− 32	....	− 35.6
	5 a. m	23.1	− 2.3	45.2	− 2.4	− 32	....	− 34.4
	7 a. m	25.6	+ 2.5	46.3	+ 1.1	− 31	....	− 29.9
	Total	....	+ 1.1	....	+ .2	+1,086	30	+1,116.2
	Total, 4 days..	....	− 2.0	....	+ 4.9	+5,560	185	+5,749.9
	Experiment No. 38.							
15–16...	9 a. m	90.5	+64.9	46.0	− .3	+ 64	4	+ 67.7
	11 a. m	101.1	+10.6	49.6	+ 3.6	+ 248	4	+ 255.6
	1 p. m	90.5	−10.6	49.9	+ .3	+ 252	4	+ 256.3
	3 p. m	101.7	+11.2	53.1	+ 3.2	+ 128	4	+ 135.2
	5 p. m	111.7	+10.0	52.8	− .3	+ 312	4	+ 315.7
	7 p. m	80.0	−31.7	51.8	− 1.0	+ 231	3	+ 233.0
	9 p. m	46.3	−33.7	49.7	− 2.1	+ 14	....	+ 11.9
	11 p. m	37.3	− 9.0	46.3	− 3.4	0	....	− 3.4
	1 a. m	28.0	− 9.3	49.9	+ 3.6	− 42	....	− 38.4
	3 a. m	26.1	− 1.9	51.4	+ 1.5	− 42	....	- 40.5
	5 a. m	26.4	+ .3	51.2	− .2	− 42	....	− 42.2
	7 a. m	26.2	− .2	47.6	− 3.6	− 41	....	− 44.6
	Total	....	+ .6	....	+ 1.3	+1,082	23	+1,106.3
16–17...	9 a. m	81.8	+55.6	51.8	+ 4.2	+ 92	5	+ 101.2
	11 a. m	107.4	+25.6	53.8	+ 2.0	+ 312	5	+ 319.0
	1 p. m	87.7	−19.7	44.0	− 9.8	+ 286	6	+ 282.2
	3 p. m	106.1	+18.4	56.7	+12.7	+ 156	6	+ 174.7
	5 p. m	111.2	+ 5.1	58.0	+ 1.3	+ 277	6	+ 284.3
	7 p. m	86.4	−24.8	53.1	− 4.9	+ 297	6	+ 298.1
	9 p. m	48.9	−37.5	51.0	− 2.1	+ 28	....	+ 25.9
	11 p. m	40.9	− 8.0	50.5	− .5	− 7	....	− 7.5
	1 a. m	28.2	−12.7	53.1	+ 2.6	− 15	....	− 12.4
	3 a. m	26.2	− 2.0	48.9	− 4.2	− 15	....	− 19.2
	5 a. m	25.3	− .9	48.9	0	− 15	....	− 15.0
	7 a. m	25.1	− .2	48.1	− .8	− 14	....	− 14.8
	Total	....	− 1.1	....	+ .5	+1,382	34	+1,416.5

TABLE 117.—*Comparison of residual amounts of carbon dioxid and water in the chamber at the beginning and end of each period, etc.*—Continued.

Date.	End of period.	Carbon dioxid. Total amount in chamber.	Carbon dioxid. Gain (+) or loss (−) over preceding period.	Water. Total amount of vapor remaining in chamber.	Water. Gain (+) or loss (−) over preceding period.	Water. Change in weight of absorbers. Gain (+) or loss (−).	Water. Amount absorbed by underclothes.	Water. Total amount gained (+) or lost (−) during the period.
	Experiment No. 38—Continued.							
1901.		*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
Jan. 17–18....	9 a. m	83.1	+58.0	54.5	+ 6.4	+ 78	7	+ 91.4
	11 a. m	95.5	+12.4	54.8	+ .3	+ 269	7	+ 276.3
	1 p. m	81.7	−13.8	53.5	− 1.3	+ 268	7	+ 273.7
	3 p. m	93.2	+11.5	55.8	+ 2.3	+ 135	7	+ 144.3
	5 p. m	100.7	+ 7.5	56.6	+ .8	+ 312	7	+ 319.8
	7 p. m	79.9	−20.8	54.0	− 2.6	+ 253	6	+ 256.4
	9 p. m	45.8	−34.1	49.7	− 4.3	+ 21	....	+ 16.7
	11 p. m	37.8	− 8.0	48.3	− 1.4	0	....	− 1.4
	1 a. m	26.6	−11.2	52.2	+ 3.9	− 25	....	− 21.1
	3 a. m	25.6	− 1.0	51.2	− 1.0	− 25	....	− 26.0
	5 a. m	23.2	− 2.4	48.3	− 2.9	− 25	....	− 27.9
	7 a. m	25.9	+ 2.7	47.4	− .9	− 24	....	− 24.9
	Total	....	+ .8	....	− .7	+1,237	41	+1,277.3
18–19...	9 a. m	82.0	+56.1	53.3	+ 5.9	+ 92	7	+ 104.9
	11 a. m	96.3	+14.3	56.1	+ 2.8	+ 269	7	+ 278.8
	1 p. m	75.1	−21.2	53.5	− 2.6	+ 240	6	+ 243.4
	3 p. m	89.6	+14.5	55.6	+ 2.1	+ 142	6	+ 150.1
	5 p. m	97.5	+ 7.9	56.7	+ 1.1	+ 291	6	+ 298.1
	7 p. m	73.2	−24.3	54.6	− 2.1	+ 215	6	+ 218.9
	9 p. m	44.2	−29.0	48.1	− 6.5	+ 28	....	+ 21.5
	11 p. m	34.7	− 9.5	46.9	− 1.2	− 7	....	− 8.2
	1 a. m	26.9	− 7.8	50.2	+ 3.3	− 27	....	− 23.7
	3 a. m	24.8	− 2.1	48.7	− 1.5	− 27	....	− 28.5
	5 a. m	21.7	− 3.1	45.6	− 3.1	− 27	....	− 30.1
	7 a. m	23.6	+ 1.9	46.3	+ .7	− 26	....	− 25.3
	Total	....	− 2.3	....	− 1.1	+1,163	38	+1,199.9
	Total, 4 days	....	− 2.0	....	0	+4,864	136	+5,000.0
	Experiment No. 39.							
19–20...	9 a. m	29.8	+ 6.2	44.5	− 1.8	....	4	+ 2.2
	11 a. m	30.0	+ .2	42.7	− 1.8	− 28	3	− 26.8
	1 p. m	28.0	− 2.0	43.5	+ .8	− 28	3	− 24.2
	3 p. m	26.7	− 1.3	40.8	− 2.7	− 22	3	− 21.7
	5 p. m	26.3	− .4	41.7	+ .9	− 35	3	− 31.1
	7 p. m	26.4	+ .1	41.1	− .6	− 28	3	− 25.6
	9 p. m	29.2	+ 2.8	42.2	+ 1.1	− 22	....	− 20.9
	11 p. m	27.1	− 2.1	42.2	0.0	− 14	....	− 14.0
	1 a. m	24.1	− 3.0	38.1	− 4.1	− 6	....	− 10.1
	3 a. m	21.5	− 2.6	39.9	+ 1.8	− 5	....	− 3.2
	5 a. m	23.0	+ 1.5	38.6	− 1.3	− 5	....	− 6.3
	7 a. m	29.3	+ 6.3	42.4	+ 3.8	− 5	....	− 1.2
	Total	....	+ 5.7	....	− 3.9	− 198	+19	− 182.9

TABLE 117.—*Comparison of residual amounts of carbon dioxid and water in the chamber at the beginning and end of each period, etc.*—Continued.

Date.	End of period.	Carbon dioxid.		Water.				
		Total amount in chamber.	Gain (+) or loss (−) over preceding period.	Total amount of vapor remaining in chamber.	Gain (+) or loss (−) over preceding period.	Change in weight of absorbers. Gain (+) or loss (−).	Amount absorbed by underclothes.	Total amount gained (+) or lost (−) during the period.
1901.	*Preliminary to experiment No. 40.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
Feb. 25–26...	7 p.m.	42.4	....	41.7	....	....	....	....
	9 p.m.	45.0	+ 2.6	40.9	− 0.8	....	....	− 0.8
	11 p.m.	41.4	− 3.6	39.0	− 1.9	....	....	− 1.9
	1 a.m.	29.8	−11.6	44.2	+ 5.2	....	....	+ 5.2
	3 a.m.	28.2	− 1.6	41.7	− 2.5	....	....	− 2.5
	5 a.m.	25.4	− 2.8	39.8	− 1.9	....	....	− 1.9
	7 a.m.	26.9	+ 1.5	38.3	− 1.5	....	....	− 1.5
	Total	....	−15.5	....	− 3.4	....	....	− 3.4
	Experiment No. 40.							
26–27...	9 a.m.	112.1	+85.2	55.4	+17.1	+ 156	7	+ 180.1
	11 a.m.	144.7	+32.6	56.1	+ .7	+ 432	7	+ 439.7
	1 p.m.	114.9	−29.8	51.2	− 4.9	+ 425	7	+ 427.1
	3 p.m.	135.6	+20.7	58.5	+ 7.3	+ 255	7	+ 269.3
	5 p.m.	141.6	+ 6.0	57.5	− 1.0	+ 458	7	+ 464.0
	7 p.m.	92.4	−49.2	53.8	− 3.7	+ 305	8	+ 309.3
	9 p.m.	52.2	−40.2	47.8	− 6.0	+ 15	....	+ 9.0
	11 p.m.	43.7	− 8.5	45.0	− 2.8	+ 7	....	+ 4.2
	1 a.m.	29.7	−14.0	50.2	+ 5.2	− 14	....	− 8.8
	3 a.m.	26.4	− 3.3	47.4	− 2.8	− 14	....	− 16.8
	5 a.m.	25.4	− 1.0	46.8	− .6	− 14	....	− 14.6
	7 a.m.	27.9	+ 2.5	47.1	+ .3	− 15	....	− 14.7
	Total	....	+ 1.0	....	+ 8.8	+1,996	+43	+2,047.8
27–28...	9 a.m.	87.7	+59.8	54.1	+ 7.0	+ 114	7	+ 128.0
	11 a.m.	135.6	+47.9	55.7	+ 1.6	+ 397	7	+ 405.6
	1 p.m.	106.3	−29.3	54.8	− .9	+ 368	7	+ 374.1
	3 p.m.	120.8	+14.5	55.7	+ .9	+ 213	7	+ 220.9
	5 p.m.	139.7	+18.9	58.0	+ 2.3	+ 440	7	+ 449.3
	7 p.m.	98.4	−41.3	55.1	− 2.9	+ 347	7	+ 351.1
	9 p.m.	51.7	−46.7	48.3	− 6.8	0	....	− 6.8
	11 p.m.	41.9	− 9.8	45.6	− 2.7	+ 49	....	+ 46.3
	1 a.m.	29.8	−12.1	51.3	+ 5.7	− 26	....	− 20.3
	3 a.m.	27.1	− 2.7	47.6	− 3.7	− 26	....	− 29.7
	5 a.m.	27.1	0.0	46.8	− .8	− 27	....	− 27.8
	7 a.m.	25.8	− 1.3	43.5	− 3.3	− 27	....	− 30.3
	Total	....	− 2.1	....	− 3.6	+1,822	+42	+1,860.4
28–Mar. 1	9 a.m.	105.1	+79.3	53.3	+ 9.8	+ 142	7	+ 158.8
	11 a.m.	142.0	+36.9	55.6	+ 2.3	+ 433	7	+ 442.3
	1 p.m.	109.1	−32.9	54.8	− .8	+ 355	7	+ 361.2
	3 p.m.	124.7	+15.6	56.4	+ 1.6	+ 206	7	+ 214.6
	5 p.m.	143.1	+18.4	55.4	− 1.0	+ 411	7	+ 417.0
	7 p.m.	96.7	−46.4	54.4	− 1.0	+ 312	6	+ 317.0
	9 p.m.	53.8	−42.9	48.9	− 5.5	+ 7	....	+ 1.5
	11 p.m.	43.0	−10.8	47.6	− 1.3	+ 14	....	+ 12.7
	1 a.m.	30.2	−12.8	49.9	+ 2.3	− 21	....	− 18.7

TABLE 117.—*Comparison of residual amounts of carbon dioxid and water in the chamber at the beginning and end of each period, etc.*—Continued.

Date.	End of period.	Carbon dioxid.		Water.				
		Total amount in chamber.	Gain (+) or loss (−) over preceding period.	Total amount of vapor remaining in chamber.	Gain (+) or loss (−) over preceding period.	Change in weight of absorbers. Gain (+) or loss (−).	Amount absorbed by underclothes.	Total amount gained (+) or lost (−) during the period.
1901.	*Experiment No. 40*—Continued.	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
Feb. 28–Mar. 1	3 a. m	27.4	− 2.8	47.9	− 2.0	− 21	....	− 23.0
	5 a. m	24.3	− 3.1	43.7	− 4.2	− 21	....	− 25.2
	7 a. m	27.2	+ 2.9	45.2	+ 1.5	− 22	....	− 20.5
	Total	....	+ 1.4	....	+ 1.7	+1,795	+ 41	+1,837.7
Mar. 1–2	9 a. m	106.6	+79.4	53.8	+ 8.6	+ 128	8	+ 144.6
	11 a. m	144.6	+38.0	58.7	+ 4.9	+ 404	8	+ 416.9
	1 p. m	112.8	−31.8	54.8	− 3.9	+ 390	8	+ 394.1
	3 p. m	123.4	+10.6	56.4	+ 1.6	+ 171	8	+ 180.6
	5 p. m	144.7	+21.3	58.5	+ 2.1	+ 433	8	+ 443.1
	7 p. m	101.9	−42.8	54.3	− 4.2	+ 368	7	+ 370.8
	9 p. m	52.8	−49.1	47.6	− 6.7	+ 14	....	+ 7.3
	11 p. m	44.7	− 8.1	45.8	− 1.8	+ 14	....	+ 12.2
	1 a. m	32.1	−12.6	50.2	+ 4.4	− 26	....	− 21.6
	3 a. m	27.9	− 4.2	49.7	− .5	− 26	....	− 26.5
	5 a. m	26.6	− 1.3	48.9	− .8	− 27	....	− 27.8
	7 a. m	26.6	0.0	46.8	− 2.1	− 27	....	− 29.1
	Total	....	− .6	....	+ 1.6	+1,816	+ 47	+1,864.6
	Total, 4 days	....	− .3	....	+ 8.5	+7,429	+173	+7,610.5
	Experiment No. 41.							
2–3	9 a. m	109.2	+82.6	56.7	+ 9.9	+ 142	9	+ 160.9
	11 a. m	133.2	+24.0	56.1	− .6	+ 454	9	+ 462.4
	1 p. m	98.9	−34.3	56.4	+ .3	+ 354	9	+ 363.3
	3 p. m	121.9	+23.0	59.5	+ 3.1	+ 213	9	+ 225.1
	5 p. m	131.4	+ 9.5	59.2	− .3	+ 461	9	+ 469.7
	7 p. m	97.6	−33.8	56.7	− 2.5	+ 340	9	+ 346.5
	9 p. m	48.9	−48.7	49.6	− 7.1	+ 35	....	+ 27.9
	11 p. m	39.1	− 9.8	47.3	− 2.3	+ 21	....	+ 18.7
	1 a. m	33.4	− 5.7	52.3	+ 5.0	− 21	....	− 16.0
	3 a. m	27.9	− 5.5	50.0	− 2.3	− 21	....	− 23.3
	5 a. m	26.6	− 1.3	49.7	− .3	− 21	....	− 21.3
	7 a. m	26.9	+ .3	48.9	− .8	− 22	....	− 22.8
	Total	....	+ .3	....	+ 2.1	+1,935	+ 54	+1,991.1
3–4	9 a. m	92.9	+66.0	53.8	+ 4.9	+ 142	8	+ 154.9
	11 a. m	119.3	+26.4	57.1	+ 3.3	+ 411	8	+ 422.3
	1 p. m	95.2	−24.1	55.4	− 1.7	+ 376	8	+ 382.3
	3 p. m	111.5	+16.3	56.4	+ 1.0	+ 192	9	+ 202.0
	5 p. m	126.8	+15.3	60.0	+ 3.6	+ 426	9	+ 438.6
	7 p. m	92.9	−33.9	56.4	− 3.6	+ 347	9	+ 352.4
	9 p. m	48.7	−44.2	50.2	− 6.2	+ 28	....	+ 21.8
	11 p. m	37.3	−11.4	46.6	− 3.6	+ 14	....	+ 10.4
	1 a. m	29.2	− 8.1	48.7	+ 2.1	− 23	....	− 20.9
	3 a. m	27.9	− 1.3	51.5	+ 2.8	− 23	....	− 20.2
	5 a. m	26.1	− 1.8	47.6	− 3.9	− 23	....	− 26.9
	7 a. m	29.0	+ 2.9	48.4	+ .8	− 23	....	− 22.2
	Total	....	+ 2.1	....	− .5	+1,844	+ 51	+1,894.5

TABLE 117.—*Comparison of residual amounts of carbon dioxid and water in the chamber at the beginning and end of each period, etc.*—Continued.

Date.	End of period.	Carbon dioxid.		Water.				
		Total amount in chamber.	Gain (+) or loss (−) over preceding period.	Total amount of vapor remaining in chamber.	Gain (+) or loss (−) over preceding period.	Change in weight of absorbers. Gain (+) or loss (−).	Amount absorbed by underclothes.	Total amount gained (+) or lost (−) during the period.
1901.	*Experiment No. 41*—Continued.	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
Mar. 4-5	9 a. m	103.7	+74.7	55.7	+ 7.3	+ 312	11	+ 330.3
	11 a. m	126.8	+23.1	57.4	+ 1.7	+ 468	11	+ 480.7
	1 p. m	95.0	−31.8	55.9	− 1.5	+ 376	11	+ 385.5
	3 p. m	109.7	+14.7	56.4	+ .5	+ 177	11	+ 188.5
	5 p. m	122.6	+12.9	57.4	+ 1.0	+ 411	11	+ 423.0
	7 p. m	86.2	−36.4	55.1	− 2.3	+ 333	11	+ 341.7
	9 p. m	51.5	−34.7	50.4	− 4.7	+ 28	....	+ 23.3
	11 p. m	39.9	−11.6	46.5	− 3.9	+ 28	....	+ 24.1
	1 a. m	29.2	−10.7	50.5	+ 4.0	− 23	....	− 19.0
	3 a. m	26.4	− 2.8	49.2	− 1.3	− 23	....	− 24.3
	5 a. m	25.1	− 1.3	47.9	− 1.3	− 23	....	− 24.3
	7 a. m	26.2	+ 1.1	48.2	+ .3	− 23	....	− 22.7
	Total	....	− 2.8	....	− .2	+2,041	+ 66	+2,106.8
5-6	9 a. m	103.2	+77.0	59.0	+10.8	+ 213	8	+ 231.8
	11 a. m	143.3	+40.1	61.6	− 2.6	+ 524	8	+ 534.6
	1 p. m	112.9	−30.4	58.3	− 3.3	+ 526	8	+ 530.7
	3 p. m	120.4	+ 7.5	59.0	+ .7	+ 220	8	+ 228.7
	5 p. m	129.1	+ 8.7	57.2	− 1.8	+ 439	8	+ 445.2
	7 p. m	86.9	−42.2	55.4	− 1.8	+ 291	7	+ 296.2
	9 p. m	47.4	−39.5	50.5	− 4.9	+ 35	....	+ 30.1
	11 p. m	38.8	− 8.6	48.4	− 2.1	+ 14	....	+ 11.9
	1 a. m	29.2	− 9.6	48.9	+ .5	− 21	....	− 20.5
	3 a. m	29.3	+ .1	52.6	+ 3.7	− 21	....	− 17.3
	5 a. m	23.6	− 5.7	51.3	− 1.3	− 21	....	− 22.3
	7 a. m	24.6	+ 1.0	48.2	− 3.1	− 22	....	− 25.1
	Total	....	− 1.6	....	....	+2,177	+ 47	+2,224.0
	Total, 4 days	....	− 2.0	....	+ 1.4	+7,997	+218	+8,216.4
	Experiment No. 42.							
6-7	9 a. m	33.1	+ 8.5	46.8	− 1.4	− 9	2	− 8.4
	11 a. m	30.0	− 3.1	46.1	− .7	− 9	2	− 7.7
	1 p. m	28.5	− 1.5	46.6	+ .5	− 10	2	− 7.5
	3 p. m	27.7	− .8	43.4	− 3.2	− 21	2	− 22.2
	5 p. m	25.9	− 1.8	42.4	− 1.0	− 21	2	− 20.0
	7 p. m	27.4	+ 1.5	44.3	+ 1.9	− 22	3	− 17.1
	9 p. m	25.6	− 1.8	42.4	− 1.9	− 8	....	− 9.9
	11 p. m	24.8	− .8	40.3	− 2.1	− 8	....	− 10.1
	1 a. m	24.0	− .8	40.3	0.0	− 8	....	− 8.0
	3 a. m	23.1	− .9	37.2	− 3.1	− 8	....	− 11.1
	5 a. m	24.0	+ .9	37.6	+ .4	− 8	....	− 7.6
	7 a. m	24.4	+ .4	38.6	+ 1.0	− 9	....	− 8.0
	Total	....	− .2	....	− 9.6	− 141	+ 13	− 137.6

TABLE 117.—*Comparison of residual amounts of carbon dioxid and water in the chamber at the beginning and end of each period, etc.*—Continued.

Date.	End of period.	Carbon dioxid.		Water.				
		Total amount in chamber.	Gain (+) or loss (−) over preceding period.	Total amount of vapor remaining in chamber.	Gain (+) or loss (−) over preceding period.	Change in weight of absorbers. Gain (+) or loss (−).	Amount absorbed by underclothes.	Total amount gained (+) or lost (−) during the period.
1901.	*Experiment No. 43.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
Mar. 29–30	7 a. m	26.9	....	40.1	....	....	....	....
	9 a. m	97.0	+70.1	50.9	+10.8	+ 158	11	+ 179.8
	11 a. m	120.1	+23.1	52.5	+ 1.6	+ 424	11	+ 436.6
	1 p. m	94.2	−25.9	51.5	− 1.0	+ 373	12	+ 384.0
	3 p. m	139.2	+45.0	63.1	+11.6	+ 309	11	+ 331.6
	5 p. m	137.4	− 1.8	60.0	− 3.1	+ 540	11	+ 547.9
	7 p. m	96.0	−41.4	54.1	− 5.9	+ 388	12	+ 394.1
	9 p. m	48.9	−47.1	48.7	− 5.4	+ 29	....	+ 23.6
	11 p. m	41.2	− 7.7	46.5	− 2.2	+ 28	....	+ 25.8
	1 a. m	29.7	−11.5	45.0	− 1.5	− 9	....	− 10.5
	3 a. m	28.0	− 1.7	48.1	+ 3.1	− 9	....	− 5.9
	5 a. m	25.6	− 2.4	46.0	− 2.1	− 9	....	− 11.1
	7 a. m	26.7	+ 1.1	43.5	− 2.5	− 9	....	− 11.5
	Total	....	− .2	....	+ 3.4	+2,213	+68	+2,284.4
30–31	9 a. m	93.2	+66.5	55.4	+11.9	+ 179	4	+ 194.9
	11 a. m	128.1	+34.9	57.4	+ 2.0	+ 504	5	+ 511.0
	1 p. m	96.7	−31.4	55.6	− 1.8	+ 418	5	+ 421.2
	3 p. m	105.4	+ 8.7	56.1	+ .5	+ 231	4	+ 235.5
	5 p. m	112.3	+ 6.9	55.3	− .8	+ 389	5	+ 393.2
	7 p. m	78.6	−33.7	53.6	− 1.7	+ 202	5	+ 205.3
	9 p. m	50.5	−28.1	49.9	− 3.7	+ 21	....	+ 17.3
	11 p. m	43.2	− 7.3	47.9	− 2.0	+ 35	....	+ 33.0
	1 a. m	29.3	−13.9	48.7	+ .8	− 14	....	− 13.2
	3 a. m	28.2	− 1.1	47.4	− 1.3	− 14	....	− 15.3
	5 a. m	26.2	− 2.0	46.3	− 1.1	− 14	....	− 15.1
	7 a. m	27.7	+ 1.5	50.7	+ 4.4	− 14	....	− 9.6
	Total	....	+ 1.0	....	+ 7.2	+1,923	+28	+1,958.2
31–Apr. 1	9 a. m	96.2	+68.5	54.4	+ 3.7	+ 208	5	+ 216.7
	11 a. m	104.2	+ 8.0	50.7	− 3.7	+ 389	5	+ 390.3
	1 p. m	95.0	− 9.2	53.8	+ 3.1	+ 289	5	+ 297.1
	3 p. m	130.9	+35.9	58.5	+ 4.7	+ 282	6	+ 292.7
	5 p. m	98.3	−32.6	55.9	− 2.6	+ 490	6	+ 493.4
	7 p. m	120.0	+21.7	54.6	− 1.3	+ 259	6	+ 263.7
	9 p. m	50.4	−69.6	47.9	− 6.7	+ 35	....	+ 28.3
	11 p. m	39.8	−10.6	45.0	− 2.9	+ 28	....	+ 25.1
	1 a. m	28.9	−10.9	48.9	+ 3.9	− 21	....	− 17.1
	3 a. m	26.2	− 2.7	48.4	− .5	− 21	....	− 21.5
	5 a. m	26.9	+ .7	49.5	+ 1.1	− 22	....	− 20.9
	7 a. m	26.4	− .5	46.6	− 2.9	− 22	....	− 24.9
	Total	....	− 1.3	....	− 4.1	+1,894	+33	+1,922.9
Apr. 1–2	9 a. m	92.2	+65.8	53.5	+ 6.9	+ 158	7	+ 171.9
	11 a. m	143.6	+51.4	59.0	+ 5.5	+ 433	7	+ 445.5
	1 p. m	91.4	−52.2	53.5	− 5.5	+ 288	7	+ 289.5
	3 p. m	112.5	+21.1	55.1	+ 1.6	+ 217	7	+ 225.6
	5 p. m	123.9	+11.4	54.6	− .5	+ 360	7	+ 366.5

TABLE 117.—*Comparison of residual amounts of carbon dioxid and water in the chamber at the beginning and end of each period, etc.*—Continued.

Date.	End of period.	Carbon dioxid.		Water.				
		Total amount in chamber.	Gain (+) or loss (−) over preceding period.	Total amount of vapor remaining in chamber.	Gain (+) or loss (−) over preceding period.	Change in weight of absorbers. Gain (+) or loss (−).	Amount absorbed by underclothes.	Total amount gained (+) or lost (−) during the period.
1901.	*Experiment No. 43*—Continued.	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
Apr. 1–2	7 p. m	89.2	−34.7	52.0	−2.6	+ 339	6	+ 342.4
	9 p. m	50.9	−38.3	47.8	−4.2	+ 28		+ 23.8
	11 p. m	44.5	− 6.4	47.9	+ .1	+ 21		+ 21.1
	1 a. m	30.5	−14.0	49.7	+1.8	− 10		− 8.2
	3 a. m	26.1	− 4.4	49.4	− .3	− 10		− 10.3
	5 a. m	26.4	+ .3	46.9	−2.5	− 11		− 13.5
	7 a. m	25.6	− .8	46.1	− .8	− 11		− 11.8
	Total		− .8		− .5	+1,802	+ 41	+1,842.5
	Total, 4 days		− 1.3		+6.0	+7,832	+170	+8,008.0
	Experiment No. 44.							
2–3	9 a. m	94.0	+68.4	51.0	+4.9	+ 143	18	+ 165.9
	11 a. m	123.1	+29.1	52.6	+1.6	+ 347	19	+ 367.6
	1 p. m	98.3	−24.8	51.7	− .9	+ 324	18	+ 341.1
	3 p. m	118.3	+20.0	53.6	+1.9	+ 188	19	+ 208.9
	5 p. m	147.3	+29.0	58.3	+4.7	+ 410	18	+ 432.7
	7 p. m	126.5	−20.8	53.3	−5.0	+ 468	19	+ 482.0
	9 p. m	62.6	−63.9	50.9	−2.4	+ 21		+ 18.6
	11 p. m	52.2	−10.4	50.0	− .9	+ 36		+ 35.1
	1 a. m	34.9	−17.3	52.3	+2.3	− 10		− 7.7
	3 a. m	26.4	− 8.5	50.4	−1.9	− 11		− 12.9
	5 a. m	29.0	+ 2.6	49.4	−1.0	− 11		− 12.0
	7 a. m	28.4	− .6	48.1	−1.3	− 11		− 12.3
	Total		+ 2.8		+2.0	+1,894	+111	+2,007.0
3–4	9 a. m	96.5	+68.1	49.2	+1.1	+ 143	8	+ 152.1
	11 a. m	135.1	+38.6	52.3	+3.1	+ 354	9	+ 366.1
	1 p. m	110.3	−24.8	53.3	+1.0	+ 332	9	+ 342.0
	3 p. m	137.6	+27.3	58.3	+5.0	+ 210	8	+ 223.0
	5 p. m	154.8	+17.2	53.8	−4.5	+ 460	9	+ 464.5
	7 p. m	103.2	−51.6	51.5	−2.3	+ 360	9	+ 366.7
	9 p. m	57.9	−45.3	46.9	−4.6	+ 65		+ 60.4
	11 p. m	50.4	− 7.5	44.8	−2.1	+ 14		+ 11.9
	1 a. m	31.0	−19.4	45.0	+ .2	− 19		− 18.8
	3 a. m	27.7	− 3.3	46.8	+1.8	− 20		− 18.2
	5 a. m	27.5	− .2	46.9	+ .1	− 20		− 19.9
	7 a. m	26.7	− .8	45.6	−1.3	− 20		− 21.3
	Total		− 1.7		−2.5	+1,859	+ 52	+1,908.5
4–5	9 a. m	103.8	+77.1	50.9	+5.3	+ 143	8	+ 156.3
	11 a. m	127.6	+23.8	54.8	+3.9	+ 375	9	+ 387.9
	1 p. m	101.2	−26.4	53.1	−1.7	+ 331	9	+ 338.3
	3 p. m	131.4	+30.2	58.5	+5.4	+ 238	9	+ 252.4
	5 p. m	159.4	+28.0	61.1	+2.6	+ 497	9	+ 508.6
	7 p. m	102.5	−56.9	55.9	−5.2	+ 331	9	+ 334.8

TABLE 117.—*Comparison of residual amounts of carbon dioxid and water in the chamber at the beginning and end of each period, etc.*—Continued.

Date.	End of period.	Carbon dioxid. Total amount in chamber.	Carbon dioxid. Gain (+) or loss (−) over preceding period.	Water. Total amount of vapor remaining in chamber.	Water. Gain (+) or loss (−) over preceding period.	Water. Change in weight of absorbers. Gain (+) or loss (−).	Water. Amount absorbed by underclothes.	Water. Total amount gained (+) or lost (−) during the period.
	Experiment No. 44—Continued.							
1901.		*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
Apr. 4–5	9 p. m	58.7	−43.8	48.4	−7.5	+ 43	....	+ 35.5
	11 p. m	49.7	− 9.0	47.4	−1.0	+ 14	....	+ 13.0
	1 a. m	30.5	−19.2	44.7	−2.7	− 19	....	− 21.7
	3 a. m	25.9	− 4.6	44.3	− .4	− 20	....	− 20.4
	5 a. m	28.0	+ 2.1	44.8	+ .5	− 20	....	− 19.5
	7 a. m	27.7	− .3	45.0	+ .2	− 20	....	− 19.8
	Total	....	+ 1.0	....	− .6	+1,893	+ 53	+1,945.4
5–6	9 a. m	102.7	+75.0	52.8	+7.8	+ 173	14	+ 194.8
	11 a. m	139.7	+37.0	55.2	+2.4	+ 452	15	+ 469.4
	1 p. m	112.5	−27.2	53.3	−1.9	+ 417	14	+ 429.1
	3 p. m	133.8	+21.3	58.3	+5.0	+ 252	15	+ 272.0
	5 p. m	148.8	+15.0	57.4	− .9	+ 482	14	+ 495.1
	7 p. m	113.9	−34.9	55.9	−1.5	+ 445	15	+ 458.5
	9 p. m	61.1	−52.8	49.5	−6.4	+ 42	....	+ 35.6
	11 p. m	49.1	−12.0	49.1	− .4	+ 36	....	+ 35.6
	1 a. m	30.8	−18.3	52.0	+2.9	− 9	....	− 6.1
	3 a. m	27.9	− 2.9	49.4	−2.6	− 9	....	− 11.6
	5 a. m	26.4	− 1.5	49.5	+ .1	− 9	....	− 8.9
	7 a. m	25.3	− 1.1	46.6	−2.9	− 9	....	− 11.9
	Total	....	− 2.4	....	+1.6	+2,263	+ 87	+2,351.6
	Total, 4 days	....	− .3	....	+ .5	+7,909	+303	+8,212.5
	Experiment No. 45.							
6–7	9 a. m	95.7	+70.4	53.3	+6.7	+ 144	10	+ 160.7
	11 a. m	125.5	+29.8	55.1	+1.8	+ 425	11	+ 437.8
	1 p. m	101.9	−23.6	54.0	−1.1	+ 404	11	+ 413.9
	3 p. m	116.4	+14.5	56.7	+2.7	+ 217	11	+ 230.7
	5 p. m	123.4	+ 7.0	56.1	− .6	+ 425	11	+ 435.4
	7 p. m	86.9	−36.5	53.8	−2.3	+ 281	11	+ 289.7
	9 p. m	49.1	−37.8	48.9	−4.9	+ 36	....	+ 31.1
	11 p. m	40.6	− 8.5	47.4	−1.5	+ 21	....	+ 19.5
	1 a. m	29.5	−11.1	43.7	−3.7	− 12	....	− 15.7
	3 a. m	29.7	+ .2	49.1	+5.4	− 12	....	− 6.6
	5 a. m	27.2	− 2.5	46.3	−2.8	− 13	....	− 15.8
	7 a. m	26.1	− 1.1	44.2	−2.1	− 13	....	− 15.1
	Total	....	+ .8	....	−2.4	+1,903	+ 65	+1,965.6
	Experiment No. 46.							
May 3–4	7 a. m	32.3	....	54.8	....	....	....	....
	9 a. m	102.5	+70.2	62.3	+7.5	+ 230	[a] 37.4	+ 274.9
	11 a. m	140.5	+38.0	64.9	+2.6	+ 528	37.5	+ 568.1
	1 p. m	107.7	−32.8	65.7	+ .8	+ 432	37.4	+ 470.2
	3 p. m	118.0	+10.3	66.7	+1.0	+ 258	37.5	+ 296.5
	5 p. m	141.0	+23.0	68.9	+2.2	+ 493	37.5	+ 532.7

[a] In experiments Nos. 46, 47, and 48 the figures in this column include the water collected in a small bottle under the incoming water pipe.

TABLE 117.—*Comparison of residual amounts of carbon dioxid and water in the chamber at the beginning and end of each period, etc.*—Continued.

Date.	End of period.	Carbon dioxid. Total amount in chamber.	Carbon dioxid. Gain (+) or loss (−) over preceding period.	Water. Total amount of vapor remaining in chamber.	Water. Gain (+) or loss (−) over preceding period.	Water. Change in weight of absorbers. Gain (+) or loss (−).	Water. Amount absorbed by underclothes.	Water. Total amount gained (+) or lost (−) during the period.
	Experiment No. 46—Continued.							
1901.		*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
May 3–4	7 p. m	110.2	−30.8	67.8	− 1.1	+ 459	37.4	+ 495.3
	9 p. m	55.4	−54.8	59.8	− 8.0	+ 49	....	+ 41.0
	11 p. m	43.2	−12.2	57.4	− 2.4	+ 34	....	+ 31.6
	1 a. m	32.1	−11.1	60.8	+ 3.4	− 8	....	− 4.6
	3 a. m	31.9	− .2	62.3	+ 1.5	− 8	....	− 6.5
	5 a. m	29.0	− 2.9	58.3	− 4.0	− 9	....	− 13.0
	7 a. m	28.8	− .2	57.2	− 1.1	− 9	....	− 10.1
	Total	....	− 3.5	....	+ 2.4	+2,449	224.7	+2,676.1
4–5	9 a. m	99.3	+70.5	65.4	+ 8.2	+ 194	37.6	+ 239.8
	11 a. m	129.7	+30.4	68.5	+ 3.1	+ 445	37.7	+ 485.8
	1 p. m	104.0	−25.7	63.6	− 4.9	+ 424	37.6	+ 456.7
	3 p. m	118.7	+14.7	66.8	+ 3.2	+ 265	37.6	+ 305.8
	5 p. m	130.4	+11.7	69.8	+ 3.0	+ 451	37.6	+ 491.6
	7 p. m	96.3	−34.1	66.5	− 3.3	+ 348	37.6	+ 382.3
	9 p. m	54.1	−42.2	61.3	− 5.2	+ 35	....	+ 29.8
	11 p. m	44.7	− 9.4	60.3	− 1.0	+ 21	....	+ 20.0
	1 a. m	33.9	−10.8	63.7	+ 3.4	− 8	....	− 4.6
	3 a. m	30.3	− 3.6	63.9	+ .2	− 9	....	− 8.8
	5 a. m	29.7	− .6	61.0	− 2.9	− 9	....	− 11.9
	7 a. m	28.4	− 1.3	57.4	− 3.6	− 9	....	− 12.6
	Total	....	− .4	....	+ .2	+2,148	225.7	+2,373.9
5–6	9 a. m	96.5	+68.1	64.4	+ 7.0	+ 208	34.1	+ 249.1
	11 a. m	124.5	+28.0	68.1	+ 3.7	+ 452	34.2	+ 489.9
	1 p. m	103.5	−21.0	64.4	− 3.7	+ 417	34.1	+ 447.4
	3 p. m	117.2	+13.7	67.0	+ 2.6	+ 230	34.2	+ 266.8
	5 p. m	134.6	+17.4	69.4	+ 2.4	+ 480	34.1	+ 516.5
	7 p. m	100.1	−34.5	68.1	− 1.3	+ 333	34.1	+ 365.8
	9 p. m	53.9	−46.2	57.4	−10.7	+ 41	....	+ 30.3
	11 p. m	45.6	− 8.3	54.6	− 2.8	+ 22	....	+ 19.2
	1 a. m	33.4	−12.2	62.3	+ 7.7	− 10	....	− 2.3
	3 a. m	30.2	− 3.2	61.9	− .4	− 10	....	- 10.4
	5 a. m	29.0	− 1.2	58.2	− 3.7	− 11	....	− 14.7
	7 a. m	26.7	− 2.3	53.6	− 4.6	− 11	....	− 15.6
	Total	....	− 1.7	....	− 3.8	+2,141	204.8	+2,342.0
6–7	9 a. m	94.0	+67.3	60.8	+ 7.2	+ 160	25.8	+ 193.0
	11 a. m	121.4	+27.4	64.1	+ 3.3	+ 431	25.8	+ 460.1
	1 p. m	101.1	−20.3	65.5	+ 1.4	+ 389	25.7	+ 416.1
	3 p. m	115.9	+14.8	67.5	+ 2.0	+ 223	25.8	+ 250.8
	5 p. m	132.2	+16.3	67.5	....	+ 466	25.8	+ 491.8
	7 p. m	96.8	−35.4	65.4	− 2.1	+ 327	25.8	+ 350.7
	9 p. m	56.4	−40.4	59.0	− 6.4	+ 42	....	+ 35.6
	11 p. m	47.6	− 8.8	58.4	− .6	+ 14	....	+ 13.4
	1 a. m	33.7	−13.9	62.1	+ 3.7	− 8	....	− 4.3

TABLE 117.—*Comparison of residual amounts of carbon dioxid and water in the chamber at the beginning and end of each period, etc.*—Continued.

Date.	End of period.	Carbon dioxid. Total amount in chamber.	Carbon dioxid. Gain (+) or loss (−) over preceding period.	Water. Total amount of vapor remaining in chamber.	Water. Gain (+) or loss (−) over preceding period.	Water. Change in weight of absorbers. Gain (+) or loss (−).	Water. Amount absorbed by underclothes.	Water. Total amount gained (+) or lost (−) during the period.
	Experiment No. 46—Continued.							
1901.		*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
May 6–7	3 a. m	28.5	− 5.2	58.2	− 3.9	− 9		− 12.9
	5 a. m	28.7	+ .2	56.9	− 1.3	− 9		− 10.3
	7 a. m	28.2	− .5	55.3	− 1.6	− 9		− 10.6
	Total		+ 1.5		+ 1.7	+2,017	154.7	+2,173.4
	Total, 4 days		− 4.1		+ .5	+8,755	809.9	+9,565.4
	Experiment No. 47.							
7–8	9 a. m	101.4	+73.2	62.6	+ 7.3	+ 167	[a] 33.2	+ 207.5
	11 a. m	153.5	+52.1	68.3	+ 5.7	+ 480	33.3	+ 519.0
	1 p. m	115.9	−37.6	65.4	− 2.9	+ 452	33.2	+ 482.3
	3 p. m	129.7	+13.8	68.5	+ 3.1	+ 243	33.2	+ 279.3
	5 p. m	149.8	+20.1	70.1	+ 1.6	+ 466	33.2	+ 500.8
	7 p. m	110.0	−39.8	67.0	− 3.1	+ 362	33.2	+ 392.1
	9 p. m	56.7	−53.3	56.1	−10.9	+ 34		+ 23.1
	11 p. m	51.5	− 5.2	55.6	− .5	+ 15		+ 14.5
	1 a. m	38.0	−13.5	63.7	+ 8.1	− 7		+ 1.1
	3 a. m	30.5	− 7.5	61.6	− 2.1	− 7		− 9.1
	5 a. m	29.7	− .8	58.7	− 2.9	− 7		− 9.9
	7 a. m	30.2	+ .5	55.1	− 3.6	− 7		− 10.6
	Total		+ 2.0		− .2	+2,191	199.3	+2,390.1
8–9	9 a. m	105.0	+74.8	67.1	+12.0	+ 167	25.8	+ 204.8
	11 a. m	145.7	+40.7	69.4	+ 2.3	+ 500	25.8	+ 528.1
	1 p. m	116.2	−29.5	68.5	− .9	+ 446	25.7	+ 470.8
	3 p. m	129.4	+13.2	68.8	+ .3	+ 243	25.8	+ 269.1
	5 p. m	147.0	+17.6	69.1	+ .3	+ 445	25.8	+ 471.1
	7 p. m	108.5	−38.5	65.4	− 3.7	+ 368	25.8	+ 390.1
	9 p. m	59.3	−49.2	61.1	− 4.3	+ 34		+ 29.7
	11 p. m	50.0	− 9.3	58.5	− 2.6	+ 29		+ 26.4
	1 a. m	34.1	−15.9	62.9	+ 4.4	− 17		− 12.6
	3 a. m	28.7	− 5.4	60.6	− 2.3	− 17		− 19.3
	5 a. m	28.5	− .2	57.7	− 2.9	− 18		− 20.9
	7 a. m	29.3	+ .8	54.3	− 3.4	− 18		− 21.4
	Total		− .9		− .8	+2,162	154.7	+2,315.9
9–10	9 a. m	115.1	+85.8	67.1	+12.8	+ 181	26.1	+ 219.9
	11 a. m	149.6	+34.5	71.7	+ 4.6	+ 522	26.2	+ 552.8
	1 p. m	114.9	−34.7	67.0	− 4.7	+ 444	26.1	+ 465.4
	3 p. m	124.4	+ 9.5	66.5	− .5	+ 236	26.2	+ 261.7
	5 p. m	142.9	+18.5	67.1	+ .6	+ 425	26.2	+ 451.8
	7 p. m	101.5	−41.4	68.0	+ .9	+ 340	26.1	+ 367.0
	9 p. m	63.7	−37.8	63.2	− 4.8	+ 41		+ 36.2
	11 p. m	53.0	−10.7	59.5	− 3.7	+ 35		+ 31.3
	1 a. m	34.4	−18.6	67.8	+ 8.3	− 14		− 5.7
	3 a. m	32.1	− 2.3	57.5	−10.3	− 14		− 24.3

[a] In experiments Nos. 46, 47, and 48 the figures in this column include the water collected in a small bottle under the incoming water pipe.

TABLE 117.—*Comparison of residual amounts of carbon dioxid and water in the chamber at the beginning and end of each period, etc.*—Continued.

Date.	End of period.	Carbon dioxid. Total amount in chamber.	Carbon dioxid. Gain (+) or loss (−) over preceding period.	Water. Total amount of vapor remaining in chamber.	Water. Gain (+) or loss (−) over preceding period.	Water. Change in weight of absorbers. Gain (+) or loss (−).	Water. Amount absorbed by underclothes.	Water. Total amount gained (+) or lost (−) during the period.
	Experiment No. 47—Continued.							
1901.		*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
May 9–10	5 a. m	26.4	− 5.7	55.6	− 1.9	− 14	....	− 15.9
	7 a. m	28.7	+ 2.3	53.3	− 2.3	− 14	....	− 16.3
	Total	....	− .6	....	− 1.0	+2,168	156.9	+2,323.9
10–11	9 a. m	114.3	+85.6	66.3	+13.0	+ 194	32.9	+ 239.9
	11 a. m	146.3	+32.0	67.0	+ .7	+ 515	33.0	+ 548.7
	1 p. m	117.0	−29.3	68.3	+ 1.3	+ 445	32.9	+ 479.2
	3 p. m	123.2	+ 6.2	68.8	+ .5	+ 237	33.0	+ 270.5
	5 p. m	154.2	+31.0	70.2	+ 1.4	+ 522	33.0	+ 556.4
	7 p. m	109.4	−44.8	67.3	− 2.9	+ 417	32.9	+ 447.0
	9 p. m	60.3	−49.1	61.4	− 5.9	+ 34	....	+ 28.1
	11 p. m	53.5	− 6.8	60.5	− .9	+ 35	....	+ 34.1
	1 a. m	35.0	−18.5	62.6	+ 2.1	− 12	....	− 9.9
	3 a. m	29.5	− 5.5	60.6	− 2.0	− 12	....	− 14.0
	5 a. m	23.6	− 5.9	59.3	− 1.3	− 12	....	− 13.3
	7 a. m	30.0	+ 6.4	56.2	− 3.1	− 13	....	− 16.1
	Total	....	+ 1.3	....	+ 2.9	+2,350	+197.7	+2,550.6
	Total, 4 days	....	+ 1.8	....	+ .9	+8,871	+708.6	+9,580.5
	Experiment No. 48.							
11–12	9 a. m	99.9	+69.9	63.9	+ 7.7	+ 174	[a] 21.5	+ 203.2
	11 a. m	138.5	+38.6	68.1	+ 4.2	+ 466	21.6	+ 491.8
	1 p. m	103.7	−34.8	65.0	− 3.1	+ 417	21.5	+ 435.4
	3 p. m	113.0	+ 9.3	69.3	+ 4.3	+ 236	21.6	+ 261.9
	5 p. m	131.2	+18.2	69.8	+ .5	+ 486	21.5	+ 508.0
	7 p. m	94.2	−37.0	68.8	− 1.0	+ 320	21.5	+ 340.5
	9 p. m	54.8	−39.4	64.7	− 4.1	+ 41	....	+ 36.9
	11 p. m	45.5	− 9.3	62.9	− 1.8	+ 56	....	+ 54.2
	1 a. m	34.2	−11.3	66.8	+ 3.9	− 3	....	+ .9
	3 a. m	30.8	− 3.4	64.7	− 2.1	− 3	....	− 5.1
	5 a. m	30.6	− .2	62.3	− 2.4	− 4	....	− 6.4
	7 a. m	29.0	− 1.6	56.4	− 5.9	− 4	....	− 9.9
	Total	....	− 1.0	....	+ .2	+2,182	129.2	+2,311.4
1902.	*Experiment No. 49.*							
Mar. 27–28	7 a. m	29.0	....	31.5	....	....	....	....
	9 a. m	105.5	+76.5	57.0	+25.5	+ 184	11.5	+ 221.0
	11 a. m	128.1	+22.6	52.2	− 4.8	+ 362	11.5	+ 368.7
	1 p. m	109.2	−18.9	54.0	+ 1.8	+ 313	11.5	+ 326.3
	3 p. m	136.9	+27.7	56.7	+ 2.7	+ 271	11.4	+ 285.1
	5 p. m	168.0	+31.1	62.4	+ 5.7	+ 497	11.4	+ 514.1
	7 p. m	119.8	−48.2	56.1	− 6.3	+ 462	11.4	+ 467.1
	9 p. m	61.0	−58.8	54.6	− 1.5	+ 57	....	+ 55.5
	11 p. m	53.8	− 7.2	52.8	− 1.8	+ 21	....	+ 19.2
	1 a. m	37.5	−16.3	55.1	+ 2.3	+ 4	....	+ 6.3

[a] In experiments Nos. 46, 47, and 48 the figures in this column include the water collected in a small bottle under the incoming water pipe.

TABLE 117.—*Comparison of residual amounts of carbon dioxid and water in the chamber at the beginning and end of each period, etc.*—Continued.

Date.	End of period.	Carbon dioxid. Total amount in chamber.	Carbon dioxid. Gain (+) or loss (−) over preceding period.	Water. Total amount of vapor remaining in chamber.	Water. Gain (+) or loss (−) over preceding period.	Water. Change in weight of absorbers. Gain (+) or loss (−).	Water. Amount absorbed by underclothes.	Water. Total amount gained (+) or lost (−) during the period.
1902.	*Experiment No. 49*—Continued.	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
Mar. 27–28...	3 a. m	31.1	− 6.4	52.8	− 2.3	+ 4	....	+ 1.7
	5 a. m	32.8	+ 1.7	51.5	− 1.3	+ 3	....	+ 1.7
	7 a. m	32.8	0.0	51.0	− .5	+ 3	....	+ 2.5
	Total	....	+ 3.8	....	+19.5	+2,181	68.7	+2,269.2
28–29...	9 a. m	100.9	+68.1	51.8	+ .8	+ 127	2.7	+ 130.5
	11 a. m	138.5	+37.6	58.8	+ 7.0	+ 398	2.6	+ 407.6
	1 p. m	145.2	+ 6.7	54.1	− 4.7	+ 327	2.6	+ 324.9
	3 p. m	125.3	−19.9	55.1	+ 1.0	+ 220	2.6	+ 223.6
	5 p. m	149.1	+23.8	57.7	+ 2.6	+ 441	2.6	+ 446.2
	7 p. m	98.6	−50.5	56.2	− 1.5	+ 284	2.6	+ 285.1
	9 p. m	62.9	−35.7	51.8	− 4.4	+ 36	....	+ 31.6
	11 p. m	48.3	−14.6	51.8	0.0	+ 21	....	+ 21.0
	1 a. m	37.2	−11.1	53.8	+ 2.0	+ 2	....	+ 4.0
	3 a. m	30.8	− 6.4	53.1	− .7	+ 2	....	+ 1.3
	5 a. m	29.8	− 1.0	50.2	− 2.9	+ 2	....	− .9
	7 a. m	32.1	+ 2.3	50.2	0.0	+ 1	....	+ 1.0
	Total	....	− .7	....	− .8	+1,861	15.7	+1,875.9
29–30...	9 a. m	113.9	+81.8	51.5	+ 1.3	+ 141	5.6	+ 147.9
	11 a. m	128.1	+14.2	49.9	− 1.6	+ 320	5.6	+ 324.0
	1 p. m	111.2	−16.9	52.3	+ 2.4	+ 264	5.5	+ 271.9
	3 p. m	120.6	+ 9.4	51.7	− .6	+ 185	5.5	+ 189.9
	5 p. m	155.2	+34.6	59.7	+ 8.0	+ 390	5.5	+ 403.5
	7 p. m	117.2	−38.0	58.2	− 1.5	+ 391	5.5	+ 395.0
	9 p. m	71.6	−45.6	53.5	− 4.7	+ 50	....	+ 45.3
	11 p. m	52.2	−19.4	48.2	− 5.3	+ 50	....	+ 44.7
	1 a. m	36.8	−15.4	53.8	+ 5.6	+ 15	....	+ 20.6
	3 a. m	33.3	− 3.5	55.7	+ 1.9	+ 14	....	+ 15.9
	5 a. m	31.6	− 1.7	52.2	− 3.5	+ 14	....	+ 10.5
	7 a. m	33.3	+ 1.7	50.0	− 2.2	+ 14	....	+ 11.8
	Total	....	+ 1.2	....	− .2	+1,848	+ 33.2	+1,881.0
	Total, 3 days	....	+ 4.3	....	+18.5	+5,890	+117.6	+6,026.1
	Experiment No. 50.							
30–31...	9 a. m	91.8	+58.5	49.7	− .3	+ 114	1.3	+ 115.0
	11 a. m	122.4	+30.6	53.6	+ 3.9	+ 355	1.3	+ 360.2
	1 p. m	121.9	− .5	53.3	− .3	+ 370	1.3	+ 371.0
	3 p. m	97.6	−24.3	51.5	− 1.8	+ 192	1.3	+ 191.5
	5 p. m	57.9	−39.7	50.5	− 1.0	+ 50	1.3	+ 50.3
	7 p. m	42.4	−15.5	49.7	− .8	+ 49	1.2	+ 49.4
	9 p. m	36.5	− 5.9	46.6	− 3.1	+ 14	....	+ 10.9
	11 p. m	38.8	+ 2.3	46.8	+ .2	+ 14	....	+ 14.2
	1 a. m	31.3	− 7.5	50.4	+ 3.6	− 16	....	− 12.4
	3 a. m	28.5	− 2.8	49.7	− .7	− 16	....	− 16.7
	5 a. m	29.0	+ .5	49.4	− .3	− 16	....	− 16.3
	7 a. m	29.0	0.0	47.3	− 2.1	− 16	....	− 18.1
	Total	....	− 4.3	....	− 2.7	+1,094	7.7	+1,099.0

TABLE 117.—*Comparison of residual amounts of carbon dioxid and water in the chamber at the beginning and end of each period, etc.*—Continued.

Date.	End of period.	Carbon dioxid. Total amount in chamber.	Carbon dioxid. Gain (+) or loss (−) over preceding period.	Water. Total amount of vapor remaining in chamber.	Water. Gain (+) or loss (−) over preceding period.	Water. Change in weight of absorbers. Gain (+) or loss (−).	Water. Amount absorbed by underclothes.	Water. Total amount gained (+) or lost (−) during the period.
1902.	*Experiment No. 51.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
Mar.31–Apr.1	9 a. m	33.6	+ 4.6	43.2	−4.1	+ 10	....	+ 5.9
	11 a. m	32.8	− .8	42.9	− .3	+ 9	....	+ 8.7
	1 p. m	32.6	− .2	48.1	+5.2	+ 9	....	+ 14.2
	3 p. m	34.6	+ 2.0	44.5	−3.6	− 7	....	− 10.6
	5 p. m	32.0	− 2.6	45.8	+1.3	− 7	....	− 5.7
	7 p. m	30.0	− 2.0	44.2	−1.6	− 7	....	− 8.6
	9 p. m	31.3	+ 1.3	45.5	+1.3	− 4	....	− 2.7
	11 p. m	32.9	+ 1.6	51.8	+6.3	− 4	....	+ 2.3
	1 a. m	28.4	− 4.5	45.5	−6.3	− 4	....	− 10.3
	3 a. m	25.4	− 3.0	45.5	0.0	− 3	....	− 3.0
	5 a. m	27.4	+ 2.0	46.6	+1.1	− 3	....	− 1.9
	7 a. m	28.2	+ .8	44.8	−1.8	− 3	....	− 4.8
	Total	....	− .8	....	−2.5	− 14	....	− 16.5
Apr. 1–2	9 a. m	36.2	+ 8.0	46.9	+2.1	+ 10	....	+ 12.1
	11 a. m	33.3	− 2.9	45.5	−1.4	+ 9	....	+ 7.6
	1 p. m	33.1	− .2	45.3	− .2	+ 9	....	+ 8.8
	3 p. m	33.4	+ .3	42.9	−2.4	− 4	....	− 6.4
	5 p. m	31.5	− 1.9	41.6	−1.3	− 5	....	− 6.3
	7 p. m	32.8	+ 1.3	43.4	+1.8	− 5	....	− 3.2
	9 p. m	29.2	− 3.6	40.4	−3.0	− 15	....	− 18.0
	11 p. m	30.5	+ 1.3	42.4	+2.0	− 14	....	− 12.0
	1 a. m	27.7	− 2.8	42.1	− .3	− 14	....	− 14.3
	3 a. m	26.7	− 1.0	42.1	0.0	− 14	....	− 14.0
	5 a. m	28.0	+ 1.3	41.1	−1.0	− 14	....	− 15.0
	7 a. m	27.7	− .3	41.1	0.0	− 14	....	− 14.0
	Total	....	− .5	....	−3.7	− 71	....	− 74.7
	Total, 2 days	....	− 1.3	....	−6.2	− 85	....	− 91.2
	Experiment No. 52.							
21–22	7 a. m	28.7	....	46.6	....	....	....	....
	9 a. m	84.4	+55.7	53.8	+7.2	+ 137	16.97	+ 161.17
	11 a. m	115.9	+31.5	60.3	+6.5	+ 351	16.96	+ 374.46
	1 p. m	110.7	− 5.2	61.4	+1.1	+ 388	16.96	+ 406.06
	3 p. m	114.9	+ 4.2	60.3	−1.1	+ 316	16.96	+ 331.86
	5 p. m	157.3	+42.4	65.7	+5.4	+ 574	16.96	+ 596.36
	7 p. m	111.8	−45.5	64.2	−1.5	+ 438	16.96	+ 453.46
	9 p. m	52.2	−59.6	57.7	−6.5	+ 65	....	+ 58.50
	11 p. m	44.0	− 8.2	52.2	−5.5	+ 28	....	+ 22.50
	1 a. m	32.6	−11.4	56.2	+4.0	+ 13	....	+ 17.00
	3 a. m	31.6	− 1.0	54.3	−1.9	+ 13	....	+ 11.10
	5 a. m	27.4	− 4.2	50.9	−3.4	+ 12	....	+ 8.60
	7 a. m	31.0	+ 3.6	52.6	+1.7	+ 12	....	+ 13.70
	Total	....	+ 2.3	....	+6.0	+2,347	101.77	+2,454.77
22–23	9 a. m	54.0	+23.0	55.1	+2.5	+ 144	11.75	+ 158.25
	11 a. m	122.6	+68.6	61.3	+6.2	+ 437	11.75	+ 454.95
	1 p. m	115.2	− 7.4	60.6	− .7	+ 395	11.74	+ 406.04
	3 p. m	107.6	− 7.6	58.3	−2.3	+ 245	11.74	+ 254.44

TABLE 117.—*Comparison of residual amounts of carbon dioxid and water in the chamber at the beginning and end of each period, etc.*—Continued.

Date.	End of period.	Carbon dioxid. Total amount in chamber.	Carbon dioxid. Gain (+) or loss (−) over preceding period.	Water. Total amount of vapor remaining in chamber.	Water. Gain (+) or loss (−) over preceding period.	Water. Change in weight of absorbers. Gain (+) or loss (−).	Water. Amount absorbed by underclothes.	Water. Total amount gained (+) or lost (−) during the period.
	Experiment No. 52—Continued.							
1902.		*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
Apr. 22–23...	5 p. m	136.9	+29.3	64.9	+6.6	+ 465	11.74	+ 483.34
	7 p. m	95.2	−41.7	60.3	−4.6	+ 344	11.74	+ 351.14
	9 p. m	50.2	−45.0	55.4	−4.9	+ 65	....	+ 60.10
	11 p. m	39.8	−10.4	49.9	−5.5	+ 29	....	+ 23.50
	1 a. m	34.2	− 5.6	55.1	+5.2	− 3	....	+ 2.20
	3 a. m	28.7	− 5.5	52.5	−2.6	− 3	....	− 5.60
	5 a. m	29.0	+ .3	48.6	−3.9	− 4	....	− 7.90
	7 a. m	29.3	+ .3	49.9	+1.3	− 4	....	− 2.70
	Total	....	− 1.7	....	−2.7	+2,110	70.46	+2,177.76
23–24...	9 a. m	85.2	+55.9	52.6	+2.7	+ 186	14.57	+ 203.27
	11 a. m	120.8	+35.6	62.3	+9.7	+ 416	14.56	+ 440.26
	1 p. m	115.6	− 5.2	59.5	−2.8	+ 381	14.56	+ 392.76
	3 p. m	107.6	− 8.0	65.5	+6.0	+ 216	14.56	+ 236.56
	5 p. m	129.3	+21.7	63.9	−1.6	+ 509	14.56	+ 521.96
	7 p. m	97.3	−32.0	61.5	−2.4	+ 366	14.56	+ 378.16
	9 p. m	51.5	−45.8	55.3	−6.2	+ 51	....	+ 44.80
	11 p. m	43.0	− 8.5	52.6	−2.7	+ 36	....	+ 33.30
	1 a. m	35.2	− 7.8	60.0	+7.4	+ 13	....	+ 20.40
	3 a. m	31.6	− 3.6	54.4	−5.6	+ 12	....	+ 6.40
	5 a. m	27.1	− 4.5	52.5	−1.9	+ 12	....	+ 10.10
	7 a. m	28.5	+ 1.4	51.7	− .8	+ 12	....	+ 11.20
	Total	....	− .8	....	+1.8	+2,210	87.37	+2,299.17
	Total, 3 days..	....	− .2	....	+5.1	+6,667	259.60	+6,931.70
	Experiment No. 53.							
24–25...	9 a. m	89.5	+61.0	52.2	+ .5	+ 123	8.55	+ 132.05
	11 a. m	123.7	+34.2	50.2	−2.0	+ 380	8.55	+ 386.55
	1 p. m	129.6	+ 5.9	51.0	+ .8	+ 366	8.55	+ 375.35
	3 p. m	116.0	−13.6	54.3	+3.3	+ 194	8.54	+ 205.84
	5 p. m	138.7	+22.7	59.5	+5.2	+ 373	8.54	+ 386.74
	7 p. m	103.7	−35.0	57.1	−2.4	+ 351	8.54	+ 357.14
	9 p. m	59.3	−44.4	52.5	−4.6	+ 36	....	+ 31.40
	11 p. m	51.3	− 8.0	52.8	+ .3	+ 50	....	+ 50.30
	1 a. m	34.7	−16.6	58.8	+6.0	+ 6	....	+ 12.00
	3 a. m	30.0	− 4.7	56.9	−1.9	+ 6	....	+ 4.10
	5 a. m	31.1	+ 1.1	55.4	−1.5	+ 5	....	+ 3.50
	7 a. m	30.8	− .3	54.1	−1.3	+ 5	....	+ 3.70
	Total	....	+ 2.3	....	+2.4	+1,895	51.27	+1,948.67
25–26...	9 a. m	92.2	+61.4	53.3	− .8	+ 165	13.33	+ 177.53
	11 a. m	147.8	+55.6	62.1	+8.8	+ 430	13.33	+ 452.13
	1 p. m	131.9	−15.9	55.1	−7.0	+ 395	13.33	+ 401.33
	3 p. m	120.5	−11.4	57.2	+2.1	+ 187	13.33	+ 202.43
	5 p. m	151.7	+31.2	61.0	+3.8	+ 474	13.32	+ 491.12
	7 p. m	103.5	−48.2	57.9	−3.1	+ 365	13.32	+ 375.22

TABLE 117.—*Comparison of residual amounts of carbon dioxid and water in the chamber at the beginning and end of each period, etc.*—Continued.

Date.	End of period.	Carbon dioxid. Total amount in chamber.	Carbon dioxid. Gain (+) or loss (−) over preceding period.	Water. Total amount of vapor remaining in chamber.	Water. Gain (+) or loss (−) over preceding period.	Water. Change in weight of absorbers. Gain (+) or loss (−).	Water. Amount absorbed by underclothes.	Water. Total amount gained (+) or lost (−) during the period.
	Experiment No. 53—Continued.							
1902.		*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
Apr. 25–26...	9 p. m	57.7	−45.8	54.1	− 3.8	+ 36	....	+ 32.20
	11 p. m	50.9	− 6.8	53.1	− 1.0	+ 28	....	+ 27.00
	1 a. m	35.9	−15.0	56.7	+ 3.6	− 9	....	− 5.40
	3 a. m	30.2	− 5.7	53.5	− 3.2	− 9	....	− 12.20
	5 a. m	29.2	− 1.0	51.5	− 2.0	− 9	....	− 11.00
	7 a. m	31.6	+ 2.4	48.9	− 2.6	− 9	....	− 11.60
	Total	....	+ .8	....	− 5.2	+2,044	79.96	+2,118.76
26–27...	9 a. m	92.4	+60.8	51.7	+ 2.8	+ 137	9.65	+ 149.45
	11 a. m	135.0	+42.6	57.9	+ 6.2	+ 481	9.65	+ 496.85
	1 p. m	129.7	− 5.3	57.0	− .9	+ 388	9.65	+ 396.75
	3 p. m	123.1	− 6.6	59.3	+ 2.3	+ 237	9.64	+ 248.94
	5 p. m	154.7	+31.6	62.3	+ 3.0	+ 495	9.64	+ 507.64
	7 p. m	101.2	−53.5	58.8	− 3.5	+ 301	9.64	+ 307.14
	9 p. m	57.7	−43.5	53.8	− 5.0	+ 29	....	+ 24.00
	11 p. m	47.9	− 9.8	51.5	− 2.3	+ 35	....	+ 32.70
	1 a. m	32.9	−15.0	56.1	+ 4.6	+ 2	....	+ 6.60
	3 a. m	33.1	+ .2	52.5	− 3.6	+ 2	....	− 1.60
	5 a. m	32.3	− .8	54.4	+ 1.9	+ 2	....	+ 3.90
	7 a. m	31.6	− .7	50.0	− 4.4	+ 1	....	− 3.40
	Total	....	0.0	....	+ 1.1	+2,110	57.87	+2,168.97
	Total, 3 days	....	+ 3.1	....	− 1.7	+6,049	189.10	+6,236.40
	Experiment No. 54.							
27–28...	9 a. m	91.6	+60.0	52.6	+ 2.6	+ 143	11.87	+ 157.47
	11 a. m	127.5	+35.9	57.4	+ 4.8	+ 417	11.86	+ 433.66
	1 p. m	115.7	−11.8	52.3	− 5.1	+ 373	11.86	+ 379.76
	3 p. m	110.7	− 5.0	57.0	+ 4.7	+ 187	11.86	+ 203.56
	5 p. m	136.8	+26.1	61.3	+ 4.3	+ 460	11.86	+ 476.16
	7 p. m	103.5	−33.3	60.0	− 1.3	+ 380	11.86	+ 390.56
	9 p. m	56.4	−47.1	50.9	− 9.1	+ 36	....	+ 26.90
	11 p. m	44.2	−12.2	51.2	+ .3	+ 35	....	+ 35.30
	1 a. m	34.6	− 9.6	58.0	+ 6.8	+ 8	....	+ 14.80
	3 a. m	30.2	− 4.4	55.7	− 2.3	+ 7	....	+ 4.70
	5 a. m	28.5	− 1.7	52.8	− 2.9	+ 7	....	+ 4.10
	7 a. m	32.8	+ 4.3	50.2	− 2.6	+ 7	....	+ 4.40
	Total	....	+ 1.2	....	+ .2	+2,060	71.17	+2,131.37
28–29...	9 a. m	103.0	+70.2	56.7	+ 6.5	+ 186	11.43	+ 203.93
	11 a. m	134.3	+31.3	58.5	+ 1.8	+ 509	11.43	+ 522.23
	1 p. m	141.8	+ 7.5	52.5	− 6.0	+ 431	11.43	+ 436.43
	3 p. m	115.6	−26.2	58.8	+ 6.3	+ 195	11.43	+ 212.73
	5 p. m	147.0	+31.4	65.0	+ 6.2	+ 560	11.42	+ 577.62
	7 p. m	109.5	−37.5	60.5	− 4.5	+ 272	11.42	+ 278.92
	9 p. m	51.0	−58.5	52.5	− 8.0	+ 37	....	+ 29.00
	11 p. m	41.9	− 9.1	50.5	− 2.0	+ 35	....	+ 33.00
	1 a. m	33.6	− 8.3	56.1	+ 5.6	+ 4	....	+ 9.60

Table 117.—*Comparison of residual amounts of carbon dioxid and water in the chamber at the beginning and end of each period, etc.*—Continued.

Date.	End of period.	Carbon dioxid. Total amount in chamber.	Carbon dioxid. Gain (+) or loss (−) over preceding period.	Water. Total amount of vapor remaining in chamber.	Water. Gain (+) or loss (−) over preceding period.	Water. Change in weight of absorbers. Gain (+) or loss (−).	Water. Amount absorbed by underclothes.	Water. Total amount gained (+) or lost (−) during the period.
	Experiment No. 54—Continued.							
1902.		*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
Apr. 28–29	3 a. m	33.3	0.3	55.7	− 0.4	+ 4	....	+ 3.60
	5 a. m	29.0	− 4.3	52.5	− 3.2	+ 4	....	+ .80
	7 a. m	30.2	+ 1.2	50.7	− 1.8	+ 3	....	+ 1.20
	Total	....	− 2.6	....	+ .5	+2,240	68.56	+2,309.06
29–30	9 a. m	97.0	+66.8	57.2	+ 6.5	+ 186	11.85	+ 204.35
	11 a. m	153.7	+56.7	49.4	− 7.8	+ 509	11.85	+ 513.05
	1 p. m	119.8	−33.9	56.7	+ 7.3	+ 445	11.85	+ 464.15
	3 p. m	117.0	− 2.8	57.4	+ .7	+ 230	11.84	+ 242.54
	5 p. m	122.1	+ 5.1	58.2	+ .8	+ 374	11.84	+ 386.64
	7 p. m	91.9	−30.2	63.1	+ 4.9	+ 323	11.84	+ 339.74
	9 p. m	53.0	−38.9	60.3	− 2.8	+ 36	....	+ 33.20
	11 p. m	44.0	− 9.0	57.0	− 3.3	+ 58	....	+ 54.70
	1 a. m	33.6	−10.4	57.7	+ .7	− 5	....	− 4.30
	3 a. m	30.0	− 3.6	58.2	+ .5	− 5	....	− 4.50
	5 a. m	30.3	+ .3	55.9	− 2.3	− 6	....	− 8.30
	7 a. m	33.9	+ 3.6	54.1	− 1.8	− 6	....	− 7.80
	Total	....	+ 3.7	....	+ 3.4	+2,139	71.07	+2,213.47
	Total, 3 days	....	+ 2.3	....	+ 4.1	+6,439	210.80	+6,653.90
	Experiment No. 55.							
30-May 1	9 a. m	133.3	+99.4	68.8	+14.7	+ 395	22.62	+ 432.32
	11 a. m	161.7	+28.4	68.0	− .8	+ 688	22.62	+ 709.82
	1 p. m	161.7	....	71.6	+ 3.6	+ 530	22.62	+ 556.22
	3 p. m	141.0	−20.7	69.8	− 1.8	+ 430	23.62	+ 450.82
	5 p. m	155.7	+14.7	69.9	+ .1	+ 695	22.61	+ 717.71
	7 p. m	98.1	−57.6	65.4	− 4.5	+ 496	22.61	+ 514.11
	9 p. m	133.7	+35.6	71.1	+ 5.7	+ 446	22.61	+ 474.31
	11 p. m	142.9	+ 9.2	67.8	− 3.3	+ 660	22.61	+ 679.31
	1 a. m	142.0	− .9	65.5	− 2.3	+ 336	22.61	+ 356.31
	3 a. m	43.5	−98.5	66.8	+ 1.3	+ 335	....	+ 336.30
	5 a. m	99.4	+55.9	67.1	+ .3	+ 335	....	+ 335.30
	7 a. m	133.7	+34.3	67.8	+ .7	+ 335	....	+ 335.70
	Total	....	+99.8	....	+13.7	+5,681	203.53	+5,898.23

TABLE 118.—*Record of carbon dioxid in ventilating air current, metabolism experiments Nos. 35–55, inclusive.*

Date.	Period.	(a) Ventilation (number of liters of air).	Carbon dioxid. In incoming air. (b) Per liter.	(c) Total, $a \times b$.	(d) In outgoing air.	(e) Total excess in outgoing air, $d - c$.	(f) Correction for amount remaining in chamber.	(g) Corrected amount exhaled by subject, $e + f$.	(h) Total weight of carbon exhaled, $g \times \frac{3}{11}$.
	Preliminary to experiment No. 35.								
1900.		*Liters.*	*Mgs.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
Dec. 8–9	7 p. m. to 9 p. m	9,328	0.658	6.1	74.2	68.1	+ 2.3	70.4	19.2
	9 p. m. to 11 p. m ...	10,105	.658	6.7	74.5	67.8	+ .6	68.4	18.6
	11 p. m. to 1 a. m ...	9,328	.658	6.1	76.8	70.7	− 4.4	66.3	18.1
	Total, 6 hours.	28,761	....	18.9	225.5	206.6	− 1.5	205.1	55.9
	1 a. m. to 3 a. m	10,105	.581	5.9	65.2	59.3	− 8.1	51.2	14.0
	3 a. m. to 5 a. m	10,105	.581	5.9	61.7	55.8	+ 1.4	57.2	15.6
	5 a. m. to 7 a. m	10,105	581	5.9	56.3	50.4	+ .5	50.9	13.9
	Total, 6 hours.	30,315	....	17.7	183.2	165.5	− 6.2	159.3	43.5
	Total, ½ day ..	59,076	....	36.6	408.7	372.1	− 7.7	364.4	99.4
	Experiment No. 35.								
9–10........	7 a. m. to 9 a. m	10,105	.562	5.7	88.1	82.4	+11.6	94.0	25.6
	9 a. m. to 11 a. m ...	9,328	.562	5.2	81.1	75.9	+ .5	76.4	20.9
	11 a. m. to 1 p. m ...	10,105	.562	5.7	77.1	71.4	− 3.8	67.6	18.4
	Total, 6 hours.	29,538	....	16.6	246.3	229.7	+ 8.3	238.0	64.9
	1 p. m. to 3 p. m	9,328	.569	5.3	79.1	73.8	+ 9.8	83.6	22.8
	3 p. m. to 5 p. m	10,105	.569	5.8	88.9	83.1	− 9.3	73.8	20.1
	5 p. m. to 7 p. m	10,105	.569	5.8	79.6	73.8	+ 3.3	77.1	21.0
	Total, 6 hours.	29,538	....	16.9	247.6	230.7	+ 3.8	234.5	63.9
	7 p. m. to 9 p. m	9,328	.567	5.3	80.4	75.1	− .6	74.5	20.3
	9 p. m. to 11 p. m ...	10,105	.567	5.7	79.7	74.0	− 1.2	72.8	19.9
	11 p. m. to 1 a. m ...	9,328	.567	5.3	64.2	58.9	− 9.4	49.5	13.5
	Total, 6 hours.	28,761	....	16.3	224.3	208.0	−11.2	196.8	53.7
	1 a. m. to 3 a. m	10,105	.567	5.7	50.8	45.1	− .7	44.4	12.1
	3 a. m. to 5 a. m	9,328	.567	5.3	56.5	51.2	− 1.8	49.4	13.5
	5 a. m. to 7 a. m	10,105	.567	5.7	54.2	48.5	− .5	48.0	13.1
	Total, 6 hours.	29,538	....	16.7	161.5	144.8	− 3.0	141.8	38.7
	Total, 1 day ..	117,375	....	66.5	879.7	813.2	− 2.1	811.1	221.2
10–11.....	7 a. m. to 9 a. m	10,105	.565	5.7	82.9	77.2	+15.3	92.5	25.2
	9 a. m. to 11 a. m ...	9,328	.565	5.3	80.3	75.0	− 4.7	70.3	19.2
	11 a. m. to 1 p. m ...	10,105	.565	5.7	77.1	71.4	− 2.4	69.0	18.8
	Total, 6 hours.	29,538	....	16.7	240.3	223.6	+ 8.2	231.8	63.2
	1 p. m. to 3 p. m	9,328	.571	5.3	77.5	72.2	+16.1	88.3	24.1
	3 p. m. to 5 p. m	9,328	.571	5.3	86.9	81.6	−11.7	69.9	19.1
	5 p. m. to 7 p. m	10,105	.571	5.8	77.6	71.8	− 1.0	70.8	19.3
	Total, 6 hours.	28,761	....	16.4	242.0	225.6	+ 3.4	229.0	62.5
	7 p. m. to 9 p. m	9,328	.588	5.5	70.3	64.8	− 5.1	59.7	16.3
	9 p. m. to 11 p. m ...	10,105	.588	5.9	68.4	62.5	+ 5.3	67.8	18.5
	11 p. m. to 1 a. m ...	10,105	.588	5.9	77.0	71.1	− 5.1	66.0	18.0
	Total, 6 hours.	29,538	....	17.3	215.7	198.4	− 4.9	193.5	52.8

TABLE 118.—*Record of carbon dioxid in ventilating air current, etc.*—Continued.

Date.	Period.	(*a*) Ventilation (number of liters of air).	Carbon dioxid. In incoming air. (*b*) Per liter.	(*c*) Total, $a \times b$.	(*d*) In outgoing air.	(*e*) Total excess in outgoing air, $d - c$.	(*f*) Correction for amount remaining in chamber.	(*g*) Corrected amount exhaled by subject, $e + f$.	(*h*) Total weight of carbon exhaled, $g \times \frac{3}{11}$.
	Experiment No. 35—Continued.								
1900.		*Liters.*	*Mgs.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
Dec. 10–11.....	1 a. m. to 3 a. m	9,328	0.591	5.5	60.8	55.3	− 3.4	51.9	14.2
	3 a. m. to 5 a.m.....	10,105	.591	6.0	60.0	54.0	− 2.5	51.5	14.0
	5 a. m. to 7 a. m	10,105	.591	6.0	55.6	49.6	+ .4	50.0	13.6
	Total, 6 hours.	29,538	....	17.5	176.4	158.9	− 5.5	153.4	41.8
	Total, 1 day...	117,375	....	67.9	874.4	806.5	+ 1.2	807.7	220.3
11–12.....	7 a. m. to 9 a. m	10,105	.600	6.1	79.6	73.5	+14.6	88.1	24.0
	9 a. m. to 11 a. m ...	9,328	.600	5.6	80.4	74.8	− 3.2	71.6	19.5
	11 a. m. to 1 p. m...	9,328	.600	5.6	70.0	64.4	− 4.3	60.1	16.4
	Total, 6 hours.	28,761	....	17.3	230.0	212.7	+ 7.1	219.8	59.9
	1 p. m. to 3 p. m....	9,328	.577	5.4	77.8	72.4	+17.6	90.0	24.6
	3 p. m. to 5 p. m....	9,328	.577	5.4	85.9	80.5	−13.8	66.7	18.2
	5 p. m. to 7 p. m....	10,105	.577	5.8	86.9	81.1	+ 4.4	85.5	23.3
	Total, 6 hours.	28,761	....	16.6	250.6	234.0	+ 8.2	242.2	66.1
	7 p. m. to 9 p. m....	9,328	.584	5.5	83.5	78.0	− 1.2	76.8	20.9
	9 p. m. to 11 p. m...	10,105	.584	5.9	79.0	73.1	− 3.4	69.7	19.0
	11 p. m. to 1 a. m...	9,328	.584	5.5	71.8	66.3	− 9.3	57.0	15.6
	Total, 6 hours.	28,761	....	16.9	234.3	217.4	−13.9	203.5	55.5
	1 a. m. to 3 a. m	10,105	.554	5.6	58.1	52.5	− 2.4	50.1	13.7
	3 a. m. to 5 a. m	10,105	.554	5.6	57.4	51.8	+ 1.0	52.8	14.4
	5 a. m. to 7 a. m	10,105	.554	5.6	56.6	51.0	+ 1.8	52.8	14.4
	Total, 6 hours.	30,315	....	16.8	172.1	155.3	+ .4	155.7	42.5
	Total, 1 day ..	116,598	....	67.6	887.0	819.4	+ 1.8	821.2	224.0
12–13.....	7 a. m. to 9 a. m	9,328	.570	5.3	78.0	72.7	+13.6	86.3	23.5
	9 a. m. to 11 a. m...	8,551	.570	4.9	79.4	74.5	+ 1.4	75.9	20.7
	11 a. m. to 1 p. m...	9,328	.570	5.3	81.1	75.8	− 6.2	69.6	19.0
	Total, 6 hours.	27,207	....	15.5	238.5	223.0	+ 8.8	231.8	63.2
	1 p. m. to 3 p. m....	9,328	.615	5.7	81.4	75.7	+ 6.2	81.9	22.3
	3 p. m. to 5 p. m....	9,328	.615	5.7	82.4	76.7	− 3.5	73.2	20.0
	5 p. m. to 7 p. m....	9,328	.615	5.7	75.9	70.2	− 2.9	67.3	18.4
	Total, 6 hours.	27,984	....	17.1	239.7	222.6	− .2	222.4	60.7
	7 p. m. to 9 p. m....	9,328	.610	5.7	68.7	63.0	− 3.6	59.4	16.2
	9 p. m. to 11 p. m...	10,105	.610	6.2	72.3	66.1	+ 1.6	67.7	18.5
	11 p. m. to 1 a. m...	10,105	.610	6.2	76.2	70.0	− 4.7	65.3	17.8
	Total, 6 hours.	29,538	....	18.1	217.2	199.1	− 6.7	192.4	52.5
	1 a. m. to 3 a. m....	9,328	.573	5.4	60.5	55.1	− .6	54.5	14.9
	3 a. m. to 5 a. m	10,105	.573	5.8	61.6	55.8	− 1.8	54.0	14.7
	5 a. m. to 7 a. m	10,105	.573	5.8	58.1	52.3	+ .9	53.2	14.5
	Total, 6 hours.	29,538	....	17.0	180.2	163.2	− 1.5	161.7	44.1
	Total, 1 day...	114,267	....	67.7	875.6	807.9	+ .4	808.3	220.5
	Total, 4 days..	465,615	....	269.7	3,516.7	3,247.0	+ 1.3	3,248.3	886.0

TABLE 118.—*Record of carbon dioxid in ventilating air current, etc.*—Continued.

Date.	Period.	(*a*) Ventilation (number of liters of air).	Carbon dioxid. In incoming air. (*b*) Per liter.	(*c*) Total, $a \times b$.	(*d*) In outgoing air.	(*e*) Total excess in outgoing air, $d-c$.	(*f*) Correction for amount remaining in chamber.	(*g*) Corrected amount exhaled by subject, $e+f$.	(*h*) Total weight of carbon exhaled, $g \times \frac{3}{11}$.
	Experiment No. 36.	*Liters.*	*Mgs.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
1900.									
Dec. 13–14	7 a. m. to 9 a. m	10,105	0.582	5.9	76.4	70.5	+ 5.9	76.4	20.8
	9 a. m. to 11 a. m	9,328	.582	5.4	71.7	66.3	+ 1.5	67.8	18.5
	11 a. m. to 1 p. m	9,328	.582	5.4	66.8	61.4	− 2.8	58.6	16.0
	Total, 6 hours.	28,761	....	16.7	214.9	198.2	+ 4.6	202.8	55.3
	1 p. m. to 3 p. m	9,328	.593	5.5	68.3	62.8	+ 3.8	66.6	18.2
	3 p. m. to 5 p. m	9,328	.593	5.5	67.8	62.3	− 3.1	59.2	16.1
	5 p. m. to 7 p. m	9,328	.593	5.5	66.9	61.4	− 1.2	60.2	16.4
	Total, 6 hours.	27,984	....	16.5	203.0	186.5	− .5	186.0	50.7
	7 p. m. to 9 p. m	10,105	.564	5.7	70.1	64.4	− .8	63.6	17.4
	9 p. m. to 11 p. m	9,328	.564	5.3	61.8	56.5	+ 1.1	57.6	15.7
	11 p. m. to 1 a. m	10,105	.564	5.7	63.0	57.3	− 7.3	50.0	13.6
	Total, 6 hours.	29,538	....	16.7	194.9	178.2	− 7.0	171.2	46.7
	1 a. m. to 3 a. m	10,105	.538	5.4	54.9	49.5	− .5	49.0	13.4
	3 a. m. to 5 a. m	10,105	.538	5.4	52.3	46.9	− 1.0	45.9	12.5
	5 a. m. to 7 a. m	9,647	.538	5.2	52.7	47.5	+ 8.7	56.2	15.3
	Total, 6 hours.	29,857	....	16.0	159.9	143.9	+ 7.2	151.1	41.2
	Total, 1 day	116,140	....	65.9	772.7	706.8	+ 4.3	711.1	193.9
	Preliminary to experiment No. 37.								
1901.									
Jan. 10–11	7 p. m. to 9 p. m	10,105	.592	6.0	98.8	92.8	−29.7	63.1	17.2
	9 p. m. to 11 p. m	9,328	.592	5.5	84.8	79.3	+ 1.0	80.3	21.9
	11 p. m. to 1 a. m	10,105	.592	6.0	78.9	72.9	−14.5	58.4	15.9
	Total, 6 hours.	29,538	....	17.5	262.5	245.0	−43.2	201.8	55.0
	1 a. m. to 3 a. m	10,105	.619	6.3	60.8	54.5	− 1.9	52.6	14.3
	3 a. m. to 5 a. m	10,105	.619	6.3	56.5	50.2	− 3.0	47.2	12.9
	5 a. m. to 7 a. m	10,105	.619	6.3	59.3	53.0	+ 3.5	56.5	15.4
	Total, 6 hours.	30,315	....	18.9	176.6	157.7	− 1.4	156.3	42.6
	Total, ½ day	59,853	....	36.4	439.1	402.7	−44.6	358.1	97.6
	Experiment No. 37.								
11–12	7 a. m. to 9 a. m	10,105	.605	6.1	122.3	116.2	+66.3	182.5	49.8
	9 a. m. to 11 a. m	9,328	.605	5.6	207.3	201.7	+ 9.3	211.0	57.5
	11 a. m. to 1 p. m	10,105	.605	6.1	213.2	207.1	−22.0	185.1	50.5
	Total, 6 hours.	29,538	....	17.8	542.8	525.0	+53.6	578.6	157.8
	1 p. m. to 3 p. m	9,328	.608	5.7	153.3	147.6	+ 8.5	156.1	42.6
	3 p. m. to 5 p. m	9,328	.608	5.7	206.8	201.1	+37.6	238.7	65.1
	5 p. m. to 7 p. m	10,105	.608	6.1	264.5	258.4	−43.7	214.7	58.5
	Total, 6 hours.	28,761	....	17.5	624.6	607.1	+ 2.4	609.5	166.2
	7 p. m. to 9 p. m	9,328	.596	5.6	141.8	136.2	−29.3	106.9	29.2
	9 p. m. to 11 p. m	10,105	.596	6.0	111.8	105.8	− 7.0	98.8	26.9
	11 p. m. to 1 a. m	10,105	.596	6.0	84.5	78.5	−17.5	61.0	16.6
	Total, 6 hours.	29,538	....	17.6	338.1	320.5	−53.8	266.7	72.7

TABLE 118.—*Record of carbon dioxid in ventilating air current, etc.*—Continued.

Date.	Period.	(*a*) Ventilation (number of liters of air).	Carbon dioxid. In incoming air. (*b*) Per liter.	(*c*) Total, $a \times b$.	(*d*) In outgoing air.	(*e*) Total excess in outgoing air, $d - c$.	(*f*) Correction for amount remaining in chamber.	(*g*) Corrected amount exhaled by subject, $e + f$.	(*h*) Total weight of carbon exhaled, $g \times \frac{3}{11}$.
	Experiment No. 37—Continued.								
1901.		*Liters.*	*Mgs.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
Jan. 11-12.....	1 a. m. to 3 a. m....	10,105	0.552	5.6	61.6	56.0	− 2.6	53.4	14.6
	3 a. m. to 5 a. m....	10,105	.552	5.6	58.3	52.7	− 1.4	51.3	14.0
	5 a. m. to 7 a. m....	9,328	.552	5.1	54.5	49.4	+ 1.8	51.2	14.0
	Total, 6 hours.	29,538	....	16.3	174.4	158.1	− 2.2	155.9	42.6
	Total, 1 day ..	117,375	....	69.2	1,679.9	1,610.7	0.0	1,610.7	439.3
12–13.....	7 a. m. to 9 a. m....	10,105	.595	6.0	122.5	116.5	+73.1	189.6	51.7
	9 a. m. to 11 a. m...	9,328	.595	5.6	226.4	220.8	+24.3	245.1	66.8
	11 a. m. to 1 p. m...	10,105	.595	6.0	278.8	272.8	−23.5	249.3	68.0
	Total, 6 hours.	29,538	....	17.6	627.7	610.1	+73.9	684.0	186.5
	1 p. m. to 3 p. m....	9,328	.582	5.4	191.5	186.1	+23.4	209.5	57.1
	3 p. m. to 5 p. m....	9,328	.582	5.4	260.8	255.4	+11.9	267.3	72.9
	5 p. m. to 7 p. m....	9,328	.582	5.4	251.7	246.3	−39.3	207.0	56.5
	Total, 6 hours.	27,984	....	16.2	704.0	687.8	− 4.0	683.8	186.5
	7 p. m. to 9 p. m....	10,105	.576	5.8	152.7	146.9	−44.8	102.1	27.8
	9 p. m. to 11 p. m...	10,105	.576	5.8	99.2	93.4	− 9.0	84.4	23.0
	11 p. m. to 1 a. m...	10,105	.576	5.8	76.6	70.8	−14.7	56.1	15.3
	Total, 6 hours.	30,315	....	17.4	328.5	311.1	−68.5	242.6	66.1
	1 a. m. to 3 a. m.....	10,105	.577	5.8	58.0	52.2	− 4.2	48.0	13.1
	3 a. m. to 5 a. m.....	9,328	.577	5.4	51.1	45.7	− .3	45.4	12.4
	5 a. m. to 7 a. m	10,105	.577	5.8	56.8	51.0	+ 1.7	52.7	14.4
	Total, 6 hours.	29,538	....	17.0	165.9	148.9	− 2.8	146.1	39.9
	Total, 1 day...	117,375	....	68.2	1,826.1	1,757.9	− 1.4	1,756.5	479.0
13–14.....	7 a. m. to 9 a. m.....	10,105	.583	5.9	117.7	111.8	+73.2	185.0	50.5
	9 a. m. to 11 a. m ...	9,328	.583	5.4	239.1	233.7	+39.2	272.9	74.4
	11 a. m. to 1 p. m ...	10,105	.583	5.9	282.4	276.5	−32.3	244.2	66.5
	Total, 6 hours.	29,538	....	17.2	639.2	622.0	+80.1	702.1	191.4
	1 p. m. to 3 p. m....	9,328	.585	5.5	181.9	176.4	+ 6.2	182.6	49.8
	3 p. m. to 5 p. m....	9,328	.585	5.5	239.8	234.3	− 1.7	232.6	63.4
	5 p. m. to 7 p. m....	10,105	.585	5.9	244.6	238.7	−20.8	217.9	59.4
	Total, 6 hours.	28,761	....	16.9	666.3	649.4	−16.3	633.1	172.6
	7 p. m. to 9 p. m	10,105	.595	6.0	138.3	132.3	−46.6	85.7	23.4
	9 p. m. to 11 p. m...	10,105	.595	6.0	92.8	86.8	− 1.8	85.0	23.2
	11 p. m. to 1 a. m...	10,105	.595	6.0	75.7	69.7	−15.4	54.3	14.8
	Total, 6 hours.	30,315	....	18.0	306.8	288.8	−63.8	225.0	61.4
	1 a. m. to 3 a. m	10,105	.618	6.2	58.5	52.3	− 1.3	51.0	13.9
	3 a. m. to 5 a. m	9,328	.618	5.8	52.1	46.3	− 1.3	45.0	12.3
	5 a. m. to 7 a. m	10,105	.618	6.2	55.1	48.9	+ .9	49.8	13.6
	Total, 6 hours.	29,538	....	18.2	165.7	147.5	− 1.7	145.8	39.8
	Total, 1 day...	118,152	....	70.3	1,778.0	1,707.7	− 1.7	1,706.0	465.2

TABLE 118.—*Record of carbon dioxid in ventilating air current, etc.*—Continued.

Date.	Period.	(*a*) Ventilation (number of liters of air).	Carbon dioxid. In incoming air. (*b*) Per liter.	(*c*) Total, $a \times b$.	(*d*) In outgoing air.	(*e*) Total excess in outgoing air, $d - c$.	(*f*) Correction for amount remaining in chamber.	(*g*) Corrected amount exhaled by subject, $e + f$.	(*h*) Total weight of carbon exhaled, $g \times \frac{3}{11}$.
	Experiment No. 37—Continued.								
1901.		*Liters.*	*Mgs.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
Jan. 14–15.....	7 a. m. to 9 a. m.....	10,105	0.648	6.5	103.0	96.5	+63.5	160.0	43.6
	9 a. m. to 11 a. m...	9,328	.648	6.0	219.5	213.5	+26.1	239.6	65.4
	11 a. m. to 1 p. m...	9,328	.648	6.0	231.5	225.5	−24.8	200.7	54.7
	Total, 6 hours.	28,761	....	18.5	554.0	535.5	+64.8	600.3	163.7
	1 p. m. to 3 p. m....	9,328	.595	5.6	161.0	155.4	+13.7	169.1	46.1
	3 p. m. to 5 p. m....	10,105	.595	6.0	237.6	231.6	+ 3.0	234.6	64.0
	5 p. m. to 7 p. m....	9,328	.595	5.6	207.2	201.6	−24.5	177.1	48.3
	Total, 6 hours.	28,761	....	17.2	605.8	588.6	− 7.8	580.8	158.4
	7 p. m. to 9 p. m....	10,105	.600	6.1	131.2	125.1	−37.5	87.6	23.9
	9 p. m. to 11 p. m...	10,105	.600	6.1	93.8	87.7	− 5.2	82.5	22.5
	11 p. m. to 1 a. m...	10,105	.600	6.1	72.8	66.7	−12.9	53.8	14.7
	Total, 6 hours.	30,315	....	18.3	297.8	279.5	−55.6	223.9	61.1
	1 a. m. to 3 a. m....	10,105	.589	6.0	56.5	50.5	− .5	50.0	13.6
	3 a. m. to 5 a. m....	9,328	.589	5.5	50.5	45.0	− 2.3	42.7	11.7
	5 a. m. to 7 a. m....	10,105	.589	6.0	55.5	49.5	+ 2.5	52.0	14.2
	Total, 6 hours.	29,538	....	17.5	162.5	145.0	− .3	144.7	39.5
	Total, 1 day...	117,375	....	71.5	1,620.1	1,548.6	+ 1.1	1,549.7	422.7
	Total, 4 days..	470,277	....	279.2	6,904.1	6,624.9	− 2.0	6,622.9	1,806.2
	Experiment No. 38.								
15–16.....	7 a. m. to 9 a. m....	10,105	.611	6.2	110.6	104.4	+64.9	169.3	46.1
	9 a. m. to 11 a. m...	9,328	.611	5.7	197.8	192.1	+10.6	202.7	55.3
	11 a. m. to 1 p. m...	9,328	.611	5.7	212.7	207.0	−10.6	196.4	53.6
	Total, 6 hours.	28,761	....	17.6	521.1	503.5	+64.9	568.4	155.0
	1 p. m. to 3 p. m....	9,328	.578	5.4	150.1	144.7	+11.2	155.9	42.5
	3 p. m. to 5 p. m....	10,105	.578	5.8	231.9	226.1	+10.0	236.1	64.4
	5 p. m. to 7 p. m....	9,328	.578	5.4	213.7	208.3	−31.7	176.6	48.1
	Total, 6 hours.	28,761	....	16.6	595.7	579.1	−10.5	568.6	155.0
	7 p. m. to 9 p. m....	10,105	.634	6.4	123.8	117.4	−33.7	83.7	22.8
	9 p. m. to 11 p. m...	10,105	.634	6.4	89.6	83.2	− 9.0	74.2	20.2
	11 p. m. to 1 a. m...	10,105	.634	6.4	74.2	67.8	− 9.3	58.5	16.0
	Total, 6 hours..	30,315	....	19.2	287.6	268.4	−52.0	216.4	59.0
	1 a. m. to 3 a. m....	10,105	.617	6.2	58.5	52.3	− 1.9	50.4	13.7
	3 a. m. to 5 a. m....	9,328	.617	5.7	53.3	47.6	+ .3	47.9	13.1
	5 a. m. to 7 a. m....	10,105	.617	6.2	56.5	50.3	− .2	50.1	13.7
	Total, 6 hours.	29,538	....	18.1	168.3	150.2	− 1.8	148.4	40.5
	Total, 1 day...	117,375	....	71.5	1,572.7	1,501.2	+ .6	1,501.8	409.5
16–17.....	7 a. m. to 9 a. m....	10,105	.616	6.2	104.2	98.0	+55.6	153.6	41.9
	9 a. m. to 11 a. m...	9,328	.616	5.7	201.9	196.2	+25.6	221.8	60.5
	11 a. m. to 1 p. m...	9,328	.616	5.7	219.8	214.1	−19.7	194.4	53.0
	Total, 6 hours.	28,761	....	17.6	525.9	508.3	+61.5	569.8	155.4

TABLE 118.—*Record of carbon dioxid in ventilating air current, etc.*—Continued.

Date.	Period.	(*a*) Ventilation (number of liters of air).	Carbon dioxid. In incoming air. (*b*) Per liter.	Carbon dioxid. In incoming air. (*c*) Total, $a \times b$.	Carbon dioxid. (*d*) In outgoing air.	Carbon dioxid. (*e*) Total excess in outgoing air, $d-c$.	Carbon dioxid. (*f*) Correction for amount remaining in chamber.	Carbon dioxid. (*g*) Corrected amount exhaled by subject, $e+f$.	(*h*) Total weight of carbon exhaled, $g \times \frac{3}{11}$.
	Experiment No. 38—Continued.								
1901.		*Liters.*	*Mgs.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
Jan. 16–17......	1 p. m. to 3 p. m....	9,328	0.620	5.8	162.7	156.9	+18.4	175.3	47.8
	3 p. m. to 5 p. m....	9,328	.620	5.8	228.1	222.3	+ 5.1	227.4	62.0
	5 p. m. to 7 p. m....	9,328	.620	5.8	213.2	207.4	−24.8	182.6	49.8
	Total, 6 hours..	27,984	....	17.4	604.0	586.6	− 1.3	585.3	159.6
	7 p. m. to 9 p. m....	8,551	.624	5.3	117.4	112.1	−37.5	74.6	20.4
	9 p. m. to 11 p. m...	10,105	.624	6.3	91.1	84.8	− 8.0	76.8	20.9
	11 p. m. to 1 a. m...	10,105	.624	6.3	76.8	70.5	−12.7	57.8	15.8
	Total, 6 hours.	28,761	....	17.9	285.3	267.4	−58.2	209.2	57.1
	1 a. m. to 3 a. m....	10,105	.578	5.8	60.5	54.7	− 2.0	52.7	14.4
	3 a. m. to 5 a. m....	9,328	.578	5.4	52.7	47.3	− .9	46.4	12.6
	5 a. m. to 7 a. m....	10,105	.578	5.8	55.7	49.9	− .2	49.7	13.5
	Total, 6 hours.	29,538	....	17.0	168.9	151.9	− 3.1	148.8	40.5
	Total, 1 day...	115,044	....	69.9	1,584.1	1,514.2	− 1.1	1,513.1	412.6
17–18.....	7 a. m. to 9 a. m....	10,105	.554	5.6	102.5	96.9	+58.0	154.9	42.2
	9 a. m. to 11 a. m...	9,328	.554	5.2	190.6	185.4	+12.4	197.8	53.9
	11 a. m. to 1 p. m...	9,328	.554	5.2	200.2	195.0	−13.8	181.2	49.4
	Total, 6 hours.	28,761	....	16.0	493.3	477.3	+56.6	533.9	145.5
	1 p. m. to 3 p. m....	10,105	.598	6.0	160.5	154.5	+11.5	166.0	45.3
	3 p. m. to 5 p. m....	9,328	.598	5.6	203.0	197.4	+ 7.5	204.9	55.9
	5 p. m. to 7 p. m....	10,105	.598	6.0	218.2	212.2	−20.8	191.4	52.2
	Total, 6 hours.	29,538	....	17.6	581.7	564.1	− 1.8	562.3	153.4
	7 p. m. to 9 p. m....	9,328	.576	5.4	121.7	116.3	−34.1	82.2	22.4
	9 p. m. to 11 p. m...	10,105	.576	5.8	89.9	84.1	− 8.0	76.1	20.8
	11 p. m. to 1 a. m...	10,105	.576	5.8	71.6	65.8	−11.2	54.6	14.9
	Total, 6 hours.	29,538	....	17.0	283.2	266.2	−53.3	212.9	58.1
	1 a. m. to 3 a. m....	10,105	.570	5.8	58.1	52.3	− 1.0	51.3	14.0
	3 a. m. to 5 a. m....	10,105	.570	5.8	53.7	47.9	− 2.4	45.5	12.4
	5 a. m. to 7 a. m....	10,105	.570	5.8	53.0	47.2	+ 2.7	49.9	13.6
	Total, 6 hours.	30,315	....	17.4	164.8	147.4	− .7	146.7	40.0
	Total, 1 day...	118,152	....	68.0	1,523.0	1,455.0	+ .8	1,455.8	397.0
18–19.....	7 a. m. to 9 a. m....	9,328	.537	5.0	88.6	83.6	+56.1	139.7	38.1
	9 a. m. to 11 a. m...	10,105	.537	5.4	207.3	201.9	+14.3	216.2	59.0
	11 a. m. to 1 p. m...	10,105	.537	5.4	211.5	206.1	−21.2	184.9	50.4
	Total, 6 hours.	29,538	....	15.8	507.4	491.6	+49.2	540.8	147.5
	1 p. m. to 3 p. m....	9,328	.548	5.1	135.8	130.7	+14.5	145.2	39.6
	3 p. m. to 5 p. m....	10,105	.548	5.5	209.7	204.2	+ 7.9	212.1	57.8
	5 p. m. to 7 p. m....	10,105	.548	5.5	207.5	202.0	−24.3	177.7	48.5
	Total, 6 hours.	29,538	....	16.1	553.0	536.9	− 1.9	535.0	145.9
	7 p. m. to 9 p. m....	10,105	.570	5.8	120.8	115.0	−29.0	86.0	23.5
	9 p. m. to 11 p. m...	10,105	.570	5.8	84.4	78.6	− 9.5	69.1	18.8
	11 p. m. to 1 a. m...	9,328	.570	5.3	65.7	60.4	− 7.8	52.6	14.3
	Total, 6 hours.	29,538	....	16.9	270.9	254.0	−46.3	207.7	56.6

TABLE 118.—*Record of carbon dioxid in ventilating air current, etc.*—Continued.

Date.	Period.	(*a*) Ventilation (number of liters of air).	Carbon dioxid. In incoming air. (*b*) Per liter.	(*c*) Total, $a \times b$.	(*d*) In outgoing air.	(*e*) Total excess in outgoing air, $d - c$.	(*f*) Correction for amount remaining in chamber.	(*g*) Corrected amount exhaled by subject, $e + f$.	(*h*) Total weight of carbon exhaled, $g \times \frac{3}{11}$.
	Experiment No. 38— Continued.								
1901.		*Liters.*	*Mgs.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
Jan. 18–19......	1 a. m. to 3 a. m	10,883	0.605	6.6	60.7	54.1	− 2.1	52.0	14.2
	3 a. m. to 5 a. m	10,105	.605	6.1	51.2	45.1	− 3.1	42.0	11.4
	5 a. m. to 7 a. m	10,105	.605	6.1	51.4	45.3	+ 1.9	47.2	12.9
	Total, 6 hours.	31,093	....	18.8	163.3	144.5	− 3.3	141.2	38.5
	Total, 1 day...	119,707	....	67.6	1,494.6	1,427.0	− 2.3	1,424.7	388.5
	Total, 4 days..	470,278	....	277.0	6,174.4	5,897.4	− 2.0	5,895.4	1,607.6
	Experiment No. 39.								
19–20.....	7 a. m. to 9 a. m	9,328	.549	5.1	65.4	60.3	+ 6.2	66.5	18.1
	9 a. m. to 11 a. m ...	10,105	.549	5.5	67.7	62.2	+ .2	62.4	17.0
	11 a. m. to 1 p. m ...	9,328	.549	5.1	58.3	53.2	− 2.0	51.2	14.0
	Total, 6 hours.	28,761	....	15.7	191.4	175.7	+ 4.4	180.1	49.1
	1 p. m. to 3 p. m	10,105	.588	5.9	63.7	57.8	− 1.3	56.5	15.4
	3 p. m. to 5 p. m	10,105	.588	5.9	60.8	54.9	− .4	54.5	14.9
	5 p. m. to 7 p. m	9,328	.588	5.5	55.4	49.9	+ .1	50.0	13.6
	Total, 6 hours.	29,538	....	17.3	179.9	162.6	− 1.6	161.0	43.9
	7 p. m. to 9 p. m	9,328	.577	5.4	68.1	62.7	+ 2.8	65.5	17.9
	9 p. m. to 11 p. m ...	9,328	.577	5.4	58.3	52.9	− 2.1	50.8	13.9
	11 p. m. to 1 a. m ...	10,105	.577	5.8	60.6	54.8	− 3.0	51.8	14.1
	Total, 6 hours.	28,761	....	16.6	187.0	170.4	− 2.3	168.1	45.9
	1 a. m. to 3 a. m	10,105	.600	6.1	51.1	45.0	− 2.6	42.4	11.6
	3 a. m. to 5 a. m	10,105	.600	6.1	49.8	43.7	+ 1.5	45.2	12.3
	5 a. m. to 7 a. m	10,105	.600	6.1	51.9	45.8	+ 6.3	52.1	14.2
	Total, 6 hours.	30,315	....	18.3	152.8	134.5	+ 5.2	139.7	38.1
	Total, 1 day ..	117,375	....	67.9	711.1	643.2	+ 5.7	648.9	177.0
	Preliminary to experiment No. 40.								
Feb. 25–26.....	7 p. m. to 9 p. m	10,105	.603	6.1	103.7	97.6	+ 2.6	100.2	27.3
	9 p. m. to 11 p. m ...	9,328	.603	5.6	89.7	84.1	− 3.6	80.5	22.0
	11 p. m. to 1 a. m ...	10,105	.603	6.1	78.0	71.9	−11.6	60.3	16.4
	Total, 6 hours.	29,538	....	17.8	271.4	253.6	−12.6	241.0	65.7
	1 a. m. to 3 a. m	10,105	.547	5.5	64.0	58.5	− 1.6	56.9	15.5
	3 a. m. to 5 a. m	10,105	.547	5.5	57.7	52.2	− 2.8	49.4	13.5
	5 a. m. to 7 a. m	10,105	.547	5.5	57.4	51.9	+ 1.5	53.4	14.6
	Total, 6 hours.	30,315	....	16.5	179.1	162.6	− 2.9	159.7	43.6
	Total, ½ day ..	59,853	....	34.3	450.5	416.2	−15.5	400.7	109.3
	Experiment No. 40.								
26–27.....	7 a. m. to 9 a. m	10,105	.560	5.7	123.2	117.5	+85.2	202.7	55.3
	9 a. m. to 11 a. m ...	9,328	.560	5.2	271.6	266.4	+32.6	299.0	81.6
	11 a. m. to 1 p. m ...	10,105	.560	5.7	308.8	303.1	−29.8	273.3	74.5
	Total, 6 hours.	29,538	....	16.6	703.6	687.0	+88.0	775.0	211.4

TABLE 118.—*Record of carbon dioxid in ventilating air current, etc.*—Continued.

Date.	Period.	(*a*) Ventilation (number of liters of air).	Carbon dioxid. In incoming air. (*b*) Per liter.	Carbon dioxid. In incoming air. (*c*) Total, $a \times b$.	(*d*) In outgoing air.	(*e*) Total excess in outgoing air, $d - c$.	(*f*) Correction for amount remaining in chamber.	(*g*) Corrected amount exhaled by subject, $e + f$.	(*h*) Total weight of carbon exhaled, $g \times \frac{3}{11}$.
	Experiment No. 40—Continued.								
1901.		*Liters.*	*Mgs.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
Feb. 26–27.....	1 p. m. to 3 p. m	9,328	0.541	5.1	202.5	197.4	+20.7	218.1	59.5
	3 p. m. to 5 p. m	9,328	.541	5.1	285.0	279.9	+ 6.0	285.9	78.0
	5 p. m. to 7 p. m	10,105	.541	5.5	272.4	266.9	−49.2	217.7	59.4
	Total, 6 hours.	28,761	....	15.7	759.9	744.2	−22.5	721.7	196.9
	7 p. m. to 9 p. m	10,105	.574	5.8	147.3	141.5	−40.2	101.3	27.6
	9 p. m. to 11 p. m ...	10,105	.574	5.8	100.8	95.0	− 8.5	86.5	23.6
	11 p. m. to 1 a. m ...	10,105	.574	5.8	79.1	73.3	−14.0	59.3	16.2
	Total, 6 hours.	30,315	....	17.4	327.2	309.8	−62.7	247.1	67.4
	1 a. m. to 3 a. m	10,105	.538	5.4	60.0	54.6	− 3.3	51.3	14.0
	3 a. m. to 5 a. m	10,105	.538	5.4	56.4	51.0	− 1.0	50.0	13.6
	5 a. m. to 7 a. m	10,883	.538	5.9	63.7	57.8	+ 2.5	60.3	16.4
	Total, 6 hours.	31,093	....	16.7	180.1	163.4	− 1.8	161.6	44.0
	Total, 1 day ..	119,707	....	66.4	1,970.8	1,904.4	+ 1.0	1,905.4	519.7
27–28.....	7 a. m. to 9 a. m	9,328	.531	5.0	106.3	101.3	+59.8	161.1	43.9
	9 a. m. to 11 a. m ...	10,105	.531	5.3	256.2	250.9	+47.9	298.8	81.5
	11 a. m. to 1 p. m ...	9,328	.531	5.0	269.5	264.5	−29.3	235.2	64.1
	Total, 6 hours.	28,761	....	15.3	632.0	616.7	+78.4	695.1	189.5
	1 p. m. to 3 p. m	9,328	.550	5.1	181.2	176.1	+14.5	190.6	52.0
	3 p. m. to 5 p. m	10,105	.550	5.5	289.2	283.7	+18.9	302.6	82.5
	5 p. m. to 7 p. m	9,328	.550	5.1	270.5	265.4	−41.3	224.1	61.1
	Total, 6 hours.	28,761	....	15.7	740.9	725.2	− 7.9	717.3	195.6
	7 p. m. to 9 p. m	10,105	.558	5.6	156.2	150.6	−46.7	103.9	28.3
	9 p. m. to 11 p. m ...	10,105	.558	5.6	100.4	94.8	− 9.8	85.0	23.2
	11 p. m. to 1 a. m ...	10,105	.558	5.6	80.0	74.4	−12.1	62.3	17.0
	Total, 6 hours.	30,315	....	16.8	336.6	319.8	−68.6	251.2	68.5
	1 a. m. to 3 a. m	10,883	.547	5.9	64.9	59.0	− 2.7	56.3	15.4
	3 a. m. to 5 a. m	10,105	.547	5.5	56.4	50.9	....	50.9	13.9
	5 a. m. to 7 a. m	10,105	.547	5.5	57.0	51.5	− 1.3	50.2	13.7
	Total, 6 hours.	31,093	....	16.9	178.3	161.4	− 4.0	157.4	43.0
	Total, 1 day ..	118,930	....	64.7	1,887.8	1,823.1	− 2.1	1,821.0	496.6
28–Mar.1.	7 a. m. to 9 a. m	9,328	.550	5.1	106.0	100.9	+79.3	180.2	49.1
	9 a. m. to 11 a. m ...	9,328	.550	5.1	263.7	258.6	+36.9	295.5	80.6
	11 a. m. to 1 p. m ...	9,328	.550	5.1	279.5	274.4	−32.9	241.5	65.9
	Total, 6 hours.	27,984	....	15.3	649.2	633.9	+83.3	717.2	195.6
	1 p. m. to 3 p. m	10,105	.610	6.1	205.2	199.1	+15.6	214.7	58.6
	3 p. m. to 5 p. m	9,328	.610	5.7	271.3	265.6	+18.4	284.0	77.4
	5 p. m. to 7 p. m	9,328	.610	5.7	261.7	256.0	−46.4	209.6	57.2
	Total, 6 hours.	28,761	....	17.5	738.2	720.7	−12.4	708.3	193.2

TABLE 118.—*Record of carbon dioxid in ventilating air current, etc.*—Continued.

Date.	Period.	(*a*) Ventilation (number of liters of air).	Carbon dioxid. In incoming air. (*b*) Per liter.	Carbon dioxid. In incoming air. (*c*) Total, $a \times b$.	Carbon dioxid. (*d*) In outgoing air.	Carbon dioxid. (*e*) Total excess in outgoing air, $d - c$.	Carbon dioxid. (*f*) Correction for amount remaining in chamber.	Carbon dioxid. (*g*) Corrected amount exhaled by subject, $e + f$.	(*h*) Total weight of carbon exhaled, $g \times \frac{3}{11}$.
	Experiment No. 40—Continued.								
1901.		*Liters.*	*Mgs.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
Feb. 28–Mar. 1.	7 p. m. to 9 p. m....	10,105	0.572	5.8	150.5	144.7	−42.9	101.8	27.8
	9 p. m. to 11 p. m...	10,105	.572	5.8	101.7	95.9	−10.8	85.1	23.2
	11 p. m. to 1 a. m...	10,105	.572	5.8	78.4	72.6	−12.8	59.8	16.3
	Total, 6 hours.	30,315	....	17.4	330.6	313.2	−66.5	246.7	67.3
	1 a. m. to 3 a. m....	10,105	.579	5.8	60.4	54.6	− 2.8	51.8	14.1
	3 a. m. to 5 a. m....	10,105	.579	5.8	55.4	49.6	− 3.1	46.5	12.7
	5 a. m. to 7 a. m....	10,105	.579	5.8	57.7	51.9	+ 2.9	54.8	14.9
	Total. 6 hours.	30,315	....	17.4	173.5	156.1	− 3.0	153.1	41.7
	Total, 1 day ..	117,375	....	67.6	1,891.5	1,823.9	+ 1.4	1,825.3	497.8
Mar. 1–2.......	7 a. m. to 9 a. m....	10,105	.575	5.8	114.2	108.4	+79.4	187.8	51.2
	9 a. m. to 11 a. m...	9,328	.575	5.4	260.8	255.4	+38.0	293.4	80.0
	11 a. m. to 1 p. m...	8,551	.575	4.9	270.4	265.5	−31.8	233.7	63.7
	Total, 6 hours.	27,984	....	16.1	645.4	629.3	+85.6	714.9	194.9
	1 p. m. to 3 p. m....	9,328	.561	5.2	190.9	185.7	+10.6	196.3	53.5
	3 p. m. to 5 p. m....	9,328	.561	5.2	266.7	261.5	+21.3	282.8	77.1
	5 p. m. to 7 p. m....	9,328	.561	5.2	275.9	270.7	−42.8	227.9	62.2
	Total, 6 hours.	27,984	....	15.6	733.5	717.9	−10.9	707.0	192.8
	7 p. m. to 9 p. m....	10,883	.579	6.3	175.7	169.4	−49.1	120.3	32.8
	9 p. m. to 11 p. m...	9,328	.579	5.4	96.1	90.7	− 8.1	82.6	22.5
	11 p. m. to 1 a. m...	10,105	.579	5.8	81.8	76.0	−12.6	63.4	17.3
	Total, 6 hours.	30,316	....	17.5	353.6	336.1	−69.8	266.3	72.6
	1 a. m. to 3 a. m....	10,105	.569	5.7	63.7	58.0	− 4.2	53.8	14.7
	3 a. m. to 5 a. m....	10,105	.569	5.7	60.0	54.3	− 1.3	53.0	14.5
	5 a. m. to 7 a. m....	10,105	.569	5.7	58.3	52.6	....	52.6	14.3
	Total, 6 hours.	30,315	....	17.1	182.0	164.9	− 5.5	159.4	43.5
	Total, 1 day ..	116,599	....	66.3	1,914.5	1,848.2	− .6	1,847.6	503.8
	Total, 4 days .	472,611	....	265.0	7,664.6	7,399.6	− .3	7,399.3	2,017.9
	Experiment No. 41.								
2–3.......	7 a. m. to 9 a. m....	10,105	.574	5.8	119.1	113.3	+82.6	195.9	53.4
	9 a. m. to 11 a. m...	9,328	.574	5.3	259.7	254.4	+24.0	278.4	75.9
	11 a. m. to 1 p. m...	8,551	.574	4.9	238.8	233.9	−34.3	199.6	54.4
	Total, 6 hours.	27,984	....	16.0	617.6	601.6	+72.3	673.9	183.7
	1 p. m. to 3 p. m....	10,105	.569	5.8	194.4	188.6	+23.0	211.6	57.7
	3 p. m. to 5 p. m....	9,328	.569	5.3	258.4	253.1	+ 9.5	262.6	71.6
	5 p. m. to 7 p. m....	10,105	.569	5.8	260.4	254.6	−33.8	220.8	60.2
	Total, 6 hours.	29,428	....	16.9	713.2	696.3	− 1.3	695.0	189.5
	7 p. m. to 9 p. m....	9,328	.557	5.2	130.6	125.4	−48.7	76.7	20.9
	9 p. m. to 11 p. m...	10,105	.557	5.6	90.5	84.9	− 9.8	75.1	20.5
	11 p. m. to 1 a. m...	10,105	.557	5.6	76.2	70.6	− 5.7	64.9	17.7
	Total, 6 hours.	29,538	....	16.4	297.3	280.9	−64.2	216.7	59.1

TABLE 118.—*Record of carbon dioxid in ventilating air current, etc.*—Continued.

Date.	Period.	(*a*) Ventilation (number of liters of air).	Carbon dioxid. In incoming air. (*b*) Per liter.	(*c*) Total, $a \times b$.	(*d*) In outgoing air.	(*e*) Total excess in outgoing air, $d - c$.	(*f*) Correction for amount remaining in chamber.	(*g*) Corrected amount exhaled by subject, $e + f$.	(*h*) Total weight of carbon exhaled, $g \times \frac{3}{11}$.
1901.	*Experiment No. 41*—Continued.	*Liters.*	*Mgs.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
Mar. 2–3	1 a. m. to 3 a. m	10,105	0.545	5.5	65.5	60.0	− 5.5	54.5	14.9
	3 a. m. to 5 a. m	10,105	.545	5.5	59.6	54.1	− 1.3	52.8	14.4
	5 a. m. to 7 a. m	10,105	.545	5.5	60.1	54.6	+ .3	54.9	15.0
	Total, 6 hours.	30,315	....	16.5	185.2	168.7	− 6.5	162.2	44.3
	Total, 1 day	117,275	....	65.8	1,813.3	1,747.5	+ .3	1,747.8	476.6
3–4	7 a. m. to 9 a. m	10,105	.525	5.3	105.2	99.9	+66.0	165.9	45.2
	9 a. m. to 11 a. m	9,328	.525	4.9	224.6	219.7	+26.4	246.1	67.1
	11 a. m. to 1 p. m	10,105	.525	5.3	258.2	252.9	−24.1	228.8	62.4
	Total, 6 hours.	29,538	....	15.5	588.0	572.5	+68.3	640.8	174.7
	1 p. m. to 3 p. m	9,328	.556	5.2	166.9	161.7	+16.3	178.0	48.5
	3 p. m. to 5 p. m	9,328	.556	5.2	239.9	234.7	+15.3	250.0	68.2
	5 p. m. to 7 p. m	10,105	.556	5.6	261.8	256.2	−33.9	222.3	60.6
	Total, 6 hours.	28,761	....	16.0	668.6	652.6	− 2.3	650.3	177.3
	7 p. m. to 9 p. m	9,328	.572	5.3	127.4	122.1	−44.2	77.9	21.2
	9 p. m. to 11 p. m	10,105	.572	5.8	90.4	84.6	−11.4	73.2	20.0
	11 p. m. to 1 a. m	9,328	.572	5.3	69.1	63.8	− 8.1	55.7	15.2
	Total, 6 hours.	28,761	....	16.4	286.9	270.5	−63.7	206.8	56.4
	1 a. m. to 3 a. m	10,105	.571	5.8	61.7	55.9	− 1.3	54.6	14.9
	3 a. m. to 5 a. m	10,105	.571	5.8	58.0	52.2	− 1.8	50.4	13.8
	5 a. m. to 7 a. m	9,328	.571	5.3	55.8	50.5	+ 2.9	53.4	14.6
	Total, 6 hours.	29,538	....	16.9	175.5	158.6	− .2	158.4	43.3
	Total, 1 day	116,598	....	64.8	1,719.0	1,654.2	+ 2.1	1,656.3	451.7
4–5	7 a. m. to 9 a. m	10,105	.553	5.6	109.1	103.5	+74.7	178.2	48.6
	9 a. m. to 11 a. m	9,328	.553	5.2	245.5	240.3	+23.1	263.4	71.8
	11 a. m. to 1 p. m	9,328	.553	5.2	244.5	239.3	−31.8	207.5	56.6
	Total, 6 hours.	28,761	....	16.0	599.1	583.1	+66.0	649.1	177.0
	1 p. m. to 3 p. m	9,328	.555	5.2	166.6	161.4	+14.7	176.1	48.0
	3 p. m. to 5 p. m	9,328	.555	5.2	233.2	228.0	+12.9	240.9	65.7
	5 p. m. to 7 p. m	10,105	.555	5.6	255.0	249.4	−36.4	213.0	58.1
	Total, 6 hours.	28,761	....	16.0	654.8	638.8	− 8.8	630.0	171.8
	7 p. m. to 9 p. m	10,105	.591	6.0	135.5	129.5	−34.7	94.8	25.9
	9 p. m. to 11 p. m	10,105	.591	6.0	95.1	89.1	−11.6	77.5	21.1
	11 p. m. to 1 a. m	9,328	.591	5.5	69.3	63.8	−10.7	53.1	14.5
	Total, 6 hours.	29,538	....	17.5	299.9	282.4	−57.0	225.4	61.5
	1 a. m. to 3 a. m	10,105	.600	6.1	60.2	54.1	− 2.8	51.3	14.0
	3 a. m. to 5 a. m	10,105	.600	6.1	58.3	52.2	− 1.3	50.9	13.9
	5 a. m. to 7 a. m	10.105	.600	6.1	55.0	48.9	+ 1.1	50.0	13.6
	Total, 6 hours.	30,315	....	18.3	173.5	155.2	− 3.0	152.2	41.5
	Total, 1 day	117,375	....	67.8	1,727.3	1,659.5	− 2.8	1,656.7	451.8

TABLE 118.—*Record of carbon dioxid in ventilating air current, etc.*—Continued.

Date.	Period.	(*a*) Ventilation (number of liters of air).	Carbon dioxid. In incoming air. (*b*) Per liter.	(*c*) Total, $a \times b$.	(*d*) In outgoing air.	(*e*) Total excess in outgoing air, $d - c$.	(*f*) Correction for amount remaining in chamber.	(*g*) Corrected amount exhaled by subject, $e + f$.	(*h*) Total weight of carbon exhaled, $g \times \frac{3}{11}$.
	Experiment No. 41—Continued.								
1901.		*Liters.*	*Mgs.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
Mar. 5–6	7 a. m. to 9 a. m	9,328	0.563	5.3	96.6	91.3	+77.0	168.3	45.9
	9 a. m. to 11 a. m	9,328	.563	5.3	256.4	251.1	+40.1	291.2	79.4
	11 a. m. to 1 p. m	9,328	.563	5.3	292.0	286.7	−30.4	256.3	69.9
	Total, 6 hours.	27,984	....	15.9	645.0	629.1	+86.7	715.8	195.2
	1 p. m. to 3 p. m	9,328	.547	5.1	191.3	186.2	+ 7.5	193.7	52.8
	3 p. m. to 5 p. m	8,551	.547	4.7	235.4	230.7	+ 8.7	239.4	65.3
	5 p. m. to 7 p. m	10,105	.547	5.5	248.2	242.7	−42.2	200.5	54.7
	Total, 6 hours.	27,984	....	15.3	674.9	659.6	−26.0	633.6	172.8
	7 p. m. to 9 p. m	9,328	.598	5.6	123.2	117.6	−39.5	78.1	21.3
	9 p. m. to 11 p. m	10,105	.598	6.0	87.2	81.2	− 8.6	72.6	19.8
	11 p. m. to 1 a. m	10,883	.598	6.5	82.3	75.8	− 9.6	66.2	18.1
	Total, 6 hours.	30,316	....	18.1	292.7	274.6	−57.7	216.9	59.2
	1 a. m. to 3 a. m	10,105	.595	6.0	62.1	56.1	+ .1	56.2	15.3
	3 a. m. to 5 a. m	9,328	.595	5.5	53.1	47.6	− 5.7	41.9	11.4
	5 a. m. to 7 a. m	10,105	.595	6.0	53.7	47.7	+ 1.0	48.7	13.3
	Total, 6 hours.	29,538	....	17.5	168.9	151.4	− 4.6	146.8	40.0
	Total, 1 day	115,822	....	66.8	1,781.5	1,714.7	− 1.6	1,713.1	467.2
	Total, 4 days.	467,270	....	265.2	7,041.1	6,775.9	− 2.0	6,773.9	1,847.3
	Experiment No. 42.								
6–7	7 a. m. to 9 a. m	10,105	.576	5.8	72.4	66.6	+ 8.5	75.1	20.5
	9 a. m. to 11 a. m	8,551	.576	4.9	57.1	52.2	− 3.1	49.1	13.4
	11 a. m. to 1 p. m	9,328	.576	5.4	59.6	54.2	− 1.5	52.7	14.4
	Total, 6 hours.	27,984	....	16.1	189.1	173.0	+ 3.9	176.9	48.3
	1 p. m. to 3 p. m	6,996	.558	3.8	56.0	52.2	− .8	51.4	14.0
	3 p. m. to 5 p. m	11,660	.558	6.5	58.9	52.4	− 1.8	50.6	13.8
	5 p. m. to 7 p. m	10,105	.558	5.6	57.8	52.2	+ 1.5	53.7	14.6
	Total, 6 hours.	28,761	....	15.9	172.7	156.8	− 1.1	155.7	42.4
	7 p. m. to 9 p. m	10,105	.588	5.9	59.6	53.7	− 1.8	51.9	14.2
	9 p. m. to 11 p. m	10,105	.588	5.9	54.7	48.8	− .8	48.0	13.1
	11 p. m. to 1 a. m	10,105	.588	5.9	54.6	48.7	− .8	47.9	13.1
	Total, 6 hours.	30,315	....	17.7	168.9	151.2	− 3.4	147.8	40.4
	1 a. m. to 3 a. m	10,105	.536	5.4	50.9	45.5	− .9	44.6	12.1
	3 a. m. to 5 a. m	9,328	.536	5.0	48.9	43.9	+ .9	44.8	12.2
	5 a. m. to 7 a. m	10,105	.536	5.4	54.9	49.5	+ .4	49.9	13.6
	Total, 6 hours.	29,538	....	15.8	154.7	138.9	+ .4	139.3	37.9
	Total, 1 day	116,598	....	65.5	685.4	619.9	− .2	619.7	169.0

TABLE 118.—*Record of carbon dioxid in ventilating air current, etc.*—Continued.

Date.	Period.	(*a*) Ventilation (number of liters of air).	Carbon dioxid. In incoming air. (*b*) Per liter.	(*c*) Total, $a \times b$.	(*d*) In outgoing air.	(*e*) Total excess in outgoing air, $d - c$.	(*f*) Correction for amount remaining in chamber.	(*g*) Corrected amount exhaled by subject, $e + f$.	(*h*) Total weight of carbon exhaled, $g \times \frac{3}{11}$.
1901.	*Experiment No. 43.*	*Liters.*	*Mgs.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
Mar. 29–30	7 a. m. to 9 a. m	9,328	0.700	6.5	100.5	94.0	+70.1	164.1	44.8
	9 a. m. to 11 a. m	10,105	.700	7.1	250.6	243.5	+23.1	266.6	72.7
	11 a. m. to 1 p. m	9,328	.700	6.5	246.5	240.0	−25.9	214.1	58.4
	Total, 6 hours.	28,761	....	20.1	597.6	577.5	+67.3	644.8	175.9
	1 p. m. to 3 p. m	9,328	.700	6.5	186.4	179.9	+45.0	224.9	61.3
	3 p. m. to 5 p. m	9,328	.700	6.5	274.8	268.3	− 1.8	266.5	72.7
	5 p. m. to 7 p. m	10,105	.700	7.1	274.9	267.8	−41.4	226.4	61.8
	Total, 6 hours.	28,761	....	20.1	736.1	716.0	+ 1.8	717.8	195.8
	7 p. m. to 9 p. m	10,105	.564	5.7	147.1	141.4	−47.1	94.3	25.7
	9 p. m. to 11 p. m	10,105	.564	5.7	97.9	92.2	− 7.7	84.5	23.0
	11 p. m. to 1 a. m	9,328	.564	5.3	71.1	65.8	−11.5	54.3	14.8
	Total, 6 hours.	29,538	....	16.7	316.1	299.4	−66.3	233.1	63.5
	1 a. m. to 3 a. m	10,105	.629	6.4	62.5	56.1	− 1.7	54.4	14.8
	3 a. m. to 5 a. m	10,105	.629	6.4	58.8	52.4	− 2.4	50.0	13.6
	5 a. m. to 7 a. m	10,105	.629	6.4	57.6	51.2	+ 1.1	52.3	14.3
	Total, 6 hours.	30,315	....	19.2	178.9	159.7	− 3.0	156.7	42.7
	Total, 1 day	117,375	....	76.1	1,828.7	1,752.6	− .2	1,752.4	477.9
30–31	7 a. m. to 9 a. m	9,328	.545	5.1	96.0	90.9	+66.5	157.4	42.9
	9 a. m. to 11 a. m	10,105	.545	5.5	262.4	256.9	+34.9	291.8	79.6
	11 a. m. to 1 p. m	9,328	.545	5.1	252.1	247.0	−31.4	215.6	58.8
	Total, 6 hours.	28,761	....	15.7	610.5	594.8	+70.0	664.8	181.3
	1 p. m. to 3 p. m	9,328	.633	5.9	168.8	162.9	+ 8.7	171.6	46.8
	3 p. m. to 5 p. m	9,328	.633	5.9	221.8	215.9	+ 6.9	222.8	60.8
	5 p. m. to 7 p. m	10,105	.633	6.4	223.2	216.8	−33.7	183.1	49.9
	Total, 6 hours.	28,761	....	18.2	613.8	595.6	−18.1	577.5	157.5
	7 p. m. to 9 p. m	10,105	.628	6.3	134.6	128.3	−28.1	100.2	27.3
	9 p. m. to 11 p. m	10,105	.628	6.3	97.1	90.8	− 7.3	83.5	22.8
	11 p. m. to 1 a. m	10,105	.628	6.3	77.5	71.2	−13.9	57.3	15.6
	Total, 6 hours.	30,315	....	18.9	309.2	290.3	−49.3	241.0	65.7
	1 a. m. to 3 a. m	10,105	.598	6.0	62.8	56.8	− 1.1	55.7	15.2
	3 a. m. to 5 a. m	10,105	.598	6.0	60.7	54.7	− 2.0	52.7	14.4
	5 a. m. to 7 a. m	10,883	.598	6.5	62.7	56.2	+ 1.5	57.7	15.7
	Total, 6 hours.	31,093	....	18.5	186.2	167.7	− 1.6	166.1	45.3
	Total, 1 day	118,930	....	71.3	1,719.7	1,648.4	+ 1.0	1,649.4	449.8
31–Apr. 1.	7 a. m. to 9 a. m	9,328	.517	4.8	105.1	100.3	+68.5	168.8	46.0
	9 a. m. to 11 a. m	9,328	.517	4.8	220.1	215.3	+ 8.0	223.3	60.9
	11 a. m. to 1 p. m	9,328	.517	4.8	216.6	211.8	− 9.2	202.6	55.2
	Total, 6 hours.	27,984	....	14.4	541.8	527.4	+67.3	594.7	162.1

TABLE 118.—*Record of carbon dioxid in ventilating air current, etc.*—Continued.

Date.	Period.	(a) Ventilation (number of liters of air).	Carbon dioxid. In incoming air. (b) Per liter.	(c) Total, $a \times b$.	(d) In outgoing air.	(e) Total excess in outgoing air, $d - c$.	(f) Correction for amount remaining in chamber.	(g) Corrected amount exhaled by subject, $e + f$.	(h) Total weight of carbon exhaled, $g \times \frac{3}{11}$.
1901.	*Experiment No. 43*—Continued.	*Liters.*	*Mgs.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
Mar. 31–Apr. 1.	1 p. m. to 3 p. m....	9,328	0.616	5.7	183.5	177.8	+35.9	213.7	58.3
	3 p. m. to 5 p. m....	8,551	.616	5.3	251.3	246.0	−32.6	213.4	58.2
	5 p. m. to 7 p. m....	9,328	.616	5.7	235.1	229.4	+21.7	251.1	68.5
	Total, 6 hours.	27,207	....	16.7	669.9	653.2	+25.0	678.2	185.0
	7 p. m. to 9 p. m....	10,105	.584	5.9	143.0	137.1	−69.6	67.5	18.4
	9 p. m. to 11 p. m...	9,328	.584	5.5	88.7	83.2	−10.6	72.6	19.8
	11 p. m. to 1 a. m...	10,105	.584	5.9	74.6	68.7	−10.9	57.8	15.8
	Total, 6 hours.	29,538	....	17.3	306.3	289.0	−91.1	197.9	54.0
	1 a. m. to 3 a. m....	10,105	.584	5.9	60.8	54.9	− 2.7	52.2	14.2
	3 a. m. to 5 a. m....	10,105	.584	5.9	58.0	52.1	+ .7	52.8	14.4
	5 a. m. to 7. a. m....	10,105	.584	5.9	55.9	50.0	− .5	49.5	13.5
	Total, 6 hours.	30,315	....	17.7	174.7	157.0	− 2.5	154.5	42.1
	Total, 1 day..	115,044	....	66.1	1,692.7	1,626.6	− 1.3	1,625.3	443.2
Apr. 1–2......	7 a. m. to 9 a. m....	9,328	.561	5.2	102.6	97.4	+65.8	163.2	44.5
	9 a. m. to 11 a. m...	7,774	.561	4.4	203.7	199.3	+51.4	250.7	68.4
	11 a. m. to 1 p. m...	9,328	.561	5.2	245.1	239.9	−52.2	187.7	51.2
	Total, 6 hours.	26,430	....	14.8	551.4	536.6	+65.0	601.6	164.1
	1 p. m. to 3 p. m....	8,551	.607	5.2	151.2	146.0	+21.1	167.1	45.6
	3 p. m. to 5 p. m....	9,328	.607	5.7	241.0	235.3	+11.4	246.7	67.3
	5 p. m. to 7 p. m....	9,328	.607	5.7	237.9	232.2	−34.7	197.5	53.9
	Total, 6 hours.	27,207	....	16.6	630.1	613.5	− 2.2	611.3	166.8
	7 p. m. to 9 p. m....	9,328	.571	5.3	136.0	130.7	−38.3	92.4	25.2
	9 p. m. to 11 p. m...	10,105	.571	5.8	99.6	93.8	− 6.4	87.4	23.8
	11 p. m. to 1 a. m...	10,105	.571	5.8	82.4	76.6	−14.0	62.6	17.1
	Total, 6 hours.	29,538	....	16.9	318.0	301.1	−58.7	242.4	66.1
	1 a. m. to 3 a. m....	10,105	.664	6.7	61.8	55.1	− 4.4	50.7	13.8
	3 a. m. to 5 a. m....	10,105	.664	6.7	56.5	49.8	+ .3	50.1	13.6
	5 a. m. to 7 a. m....	9,328	.664	6.2	53.0	46.8	− .8	46.0	12.5
	Total, 6 hours.	29,538	....	19.6	171.3	151.7	− 4.9	146.8	39.9
	Total, 1 day...	112,713	....	67.9	1,670.8	1,602.9	− .8	1,602.1	436.9
	Total, 4 days..	464,062	....	281.4	6,911.9	6,630.5	− 1.3	6,629.2	1,807.8
	Experiment No. 44.								
2–3.......	7 a. m. to 9 a. m....	10,105	.557	5.6	109.4	103.8	+68.4	172.2	47.0
	9 a. m. to 11 a. m...	9,328	.557	5.2	229.2	224.0	+29.1	253.1	69.0
	11 a. m. to 1 p. m...	9,328	.557	5.2	248.6	243.4	−24.8	218.6	59.6
	Total, 6 hours.	28,761	....	16.0	587.2	571.2	+72.7	643.9	175.6
	1 p. m. to 3 p. m....	9,328	.535	5.0	177.3	172.3	+20.0	192.3	52.4
	3 p. m. to 5 p. m....	8,551	.535	4.6	246.3	241.7	+29.0	270.7	73.8
	5 p. m. to 7 p. m....	9,328	.535	5.0	309.2	304.2	−20.8	283.4	77.3
	Total, 6 hours.	27,207	....	14.6	732.8	718.2	+28.2	746.4	203.5

TABLE 118.—*Record of carbon dioxid in ventilating air current, etc.*—Continued.

Date.	Period.	(a) Ventilation (number of liters of air).	Carbon dioxid. In incoming air. (b) Per liter.	(c) Total, $a \times b$.	(d) In outgoing air.	(e) Total excess in outgoing air, $d - c$.	(f) Correction for amount remaining in chamber.	(g) Corrected amount exhaled by subject, $e + f$.	(h) Total weight of carbon exhaled, $g \times \frac{3}{11}$.
	Experiment No. 44—Continued.								
1901.		*Liters.*	*Mgs.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
Apr. 2–3	7 p. m. to 9 p. m	9,328	0.611	5.7	170.9	165.2	−63.9	101.3	27.6
	9 p. m. to 11 p. m	9,328	.611	5.7	109.2	103.5	−10.4	93.1	25.4
	11 p. m. to 1 a. m	9,328	.611	5.7	87.1	81.4	−17.3	64.1	17.5
	Total, 6 hours.	27,984	....	17.1	367.2	350.1	−91.6	258.5	70.5
	1 a. m. to 3 a. m	9,328	.629	5.9	62.0	56.1	− 8.5	47.6	13.0
	3 a. m. to 5 a. m	10,105	.629	6.4	61.9	55.5	+ 2.6	58.1	15.9
	5 a. m. to 7 a. m	9,328	.629	5.9	58.1	52.2	− .6	51.6	14.1
	Total, 6 hours.	28,761	....	18.2	182.0	163.8	− 6.5	157.3	43.0
	Total, 1 day	112,713	....	65.9	1,869.2	1,803.3	+ 2.8	1,806.1	492.6
3–4	7 a. m. to 9 a. m	8,551	.615	5.3	95.4	90.1	+68.1	158.2	43.1
	9 a. m. to 11 a. m	8,551	.615	5.3	224.1	218.8	+38.6	257.4	70.2
	11 a. m. to 1 p. m	8,551	.615	5.3	251.8	246.5	−24.8	221.7	60.5
	Total, 6 hours.	25,653	....	15.9	571.3	555.4	+81.9	637.3	173.8
	1 p. m. to 3 p. m	8,551	.600	5.1	187.1	182.0	+27.3	209.3	57.1
	3 p. m. to 5 p. m	8,551	.600	5.1	273.8	268.7	+17.2	285.9	78.0
	5 p. m. to 7 p. m	10,105	.600	6.1	302.6	296.5	−51.6	244.9	66.8
	Total, 6 hours.	27,207	....	16.3	763.5	747.2	− 7.1	740.1	201.9
	7 p. m. to 9 p. m	9,328	.636	5.9	149.5	143.6	−45.3	98.3	26.8
	9 p. m. to 11 p. m	10,105	.636	6.4	113.5	107.1	− 7.5	99.6	27.2
	11 p. m. to 1 a. m	10,105	.636	6.4	83.2	76.8	−19.4	57.4	15.6
	Total, 6 hours.	29,538	....	18.7	346.2	327.5	−72.2	255.3	69.6
	1 a. m. to 3 a. m	9,328	.550	5.1	55.8	50.7	− 3.3	47.4	12.9
	3 a. m. to 5 a. m	10,105	.550	5.6	60.8	55.2	− .2	55.0	15.0
	5 a. m. to 7 a. m	10,882	.550	6.0	62.5	56.5	− .8	55.7	15.2
	Total, 6 hours.	30,315	....	16.7	179.1	162.4	− 4.3	158.1	43.1
	Total, 1 day	112,713	....	67.6	1,860.1	1,792.5	− 1.7	1,790.8	488.4
4–5	7 a. m. to 9 a. m	8,551	.584	5.0	96.9	91.9	+77.1	169.0	46.1
	9 a. m. to 11 a. m	9,328	.584	5.4	247.5	242.1	+23.8	265.9	72.5
	11 a. m. to 1 p. m	10,105	.584	5.9	279.7	273.8	−26.4	247.4	67.5
	Total, 6 hours.	27,984	....	16.3	624.1	607.8	+74.5	682.3	186.1
	1 p. m. to 3 p. m	9,328	.584	5.4	185.6	180.2	+30.2	210.4	57.4
	3 p. m. to 5 p. m	9,328	.584	5.4	288.6	283.2	+28.0	311.2	84.9
	5 p. m. to 7 p. m	10,105	.584	5.9	297.3	291.4	−56.9	234.5	63.9
	Total, 6 hours.	28,761	....	16.7	771.5	754.8	+ 1.3	756.1	206.2
	7 p. m. to 9 p. m	9,328	.595	5.6	146.0	140.4	−43.8	96.6	26.3
	9 p. m. to 11 p. m	10,105	.595	6.0	112.5	106.5	− 9.0	97.5	26.6
	11 p. m. to 1 a. m	10,105	.595	6.0	82.5	76.5	−19.2	57.3	15.6
	Total, 6 hours.	29,538	....	17.6	341.0	323.4	−72.0	251.4	68.5

TABLE 118.—*Record of carbon dioxid in ventilating air current, etc.*—Continued.

Date.	Period.	(*a*) Ventilation (number of liters of air).	Carbon dioxid. In incoming air. (*b*) Per liter.	(*c*) Total, $a \times b$.	(*d*) In outgoing air.	(*e*) Total excess in outgoing air, $d - c$.	(*f*) Correction for amount remaining in chamber.	(*g*) Corrected amount exhaled by subject, $e + f$.	(*h*) Total weight of carbon exhaled, $g \times \frac{3}{11}$.
1901.	*Experiment No. 44*—Continued.	*Liters.*	*Mgs.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
Apr. 4–5	1 a. m. to 3 a. m	10,105	0.585	5.9	60.6	54.7	− 4.6	50.1	13.7
	3 a. m. to 5 a. m	10,105	.585	5.9	58.3	52.4	+ 2.1	54.5	14.9
	5 a. m. to 7 a. m	10,105	.585	5.9	61.8	55.9	− .3	55.6	15.1
	Total, 6 hours.	30,315	....	17.7	180.7	163.0	− 2.8	160.2	43.7
	Total, 1 day	116,598	....	68.3	1,917.3	1,849.0	+ 1.0	1,850.0	504.5
5–6	7 a. m. to 9 a. m	9,328	.575	5.4	110.2	104.8	+75.0	179.8	49.0
	9 a. m. to 11 a. m	9,328	.575	5.4	258.0	252.6	+37.0	289.6	79.0
	11 a. m to 1 p. m	9,328	.575	5.4	285.5	280.1	−27.2	252.9	69.0
	Total, 6 hours.	27,984	....	16.2	653.7	637.5	+84.8	722.3	197.0
	1 p. m. to 3 p. m	10,105	.613	6.2	217.4	211.2	+21.3	232.5	63.4
	3 p. m. to 5 p. m	9,328	.613	5.7	286.9	281.2	+15.0	296.2	80.8
	5 p. m. to 7 p. m	9,328	.613	5.7	311.3	305.6	−34.9	270.7	73.8
	Total, 6 hours.	28,761	....	17.6	815.6	798.0	+ 1.4	799.4	218.0
	7 p. m. to 9 p. m	10,105	.650	6.6	173.9	167.3	−52.8	114.5	31.2
	9 p. m. to 11 p. m	9,328	.650	6.1	110.3	104.2	−12.0	92.2	25.2
	11 p. m. to 1 a. m	10,105	.650	6.6	86.3	79.7	−18.3	61.4	16.7
	Total, 6 hours.	29,538	....	19.3	370.5	351.2	−83.1	268.1	73.1
	1 a. m. to 3 a. m	10,105	.586	5.9	64.4	58.5	− 2.9	55.6	15.2
	3 a. m. to 5 a. m	10,105	.586	5.9	60.6	54.7	− 1.5	53.2	14.5
	5 a. m. to 7 a. m	10,883	.586	6.4	63.3	56.9	− 1.1	55.8	15.2
	Total, 6 hours.	31,093	....	18.2	188.3	170.1	− 5.5	164.6	44.9
	Total, 1 day	117,376	....	71.3	2,028.1	1,956.8	− 2.4	1,954.4	533.0
	Total, 4 days	459,400	....	273.1	7,674.7	7,401.6	− .3	7,401.3	2,018.5
	Experiment No. 45.								
6–7	7 a. m. to 9 a. m	9,328	.603	5.6	105.3	99.7	+70.4	170.1	46.4
	9 a. m. to 11 a. m	9,328	.603	5.6	241.6	236.0	+29.8	265.8	72.5
	11 a. m. to 1 p. m	10,105	.603	6.1	272.7	266.6	−23.6	243.0	66.3
	Total, 6 hours.	28,761	....	17.3	619.6	602.3	+76.6	678.9	185.2
	1 p. m. to 3 p. m	9,328	.664	6.2	178.7	172.5	+14.5	187.0	51.0
	3 p. m. to 5 p. m	9,328	.664	6.2	251.1	244.9	+ 7.0	251.9	68.7
	5 p. m. to 7 p. m	10,105	.664	6.7	248.4	241.7	−36.5	205.2	56.0
	Total, 6 hours.	28,761	....	19.1	678.2	659.1	−15.0	644.1	175.7
	7 p. m. to 9 p. m	9,328	.616	5.8	130.6	124.8	−37.8	87.0	23.7
	9 p. m. to 11 p. m	10,105	.616	6.2	98.4	92.2	− 8.5	83.7	22.8
	11 p. m. to 1 a. m	9,328	.616	5.8	71.5	65.7	−11.1	54.6	14.9
	Total, 6 hours.	28,761	....	17.8	300.5	282.7	−57.4	225.6	61.4
	1 a. m. to 3 a. m	10,105	.568	5.7	62.1	56.4	+ .2	56.6	15.4
	3 a. m. to 5 a. m	10,105	.568	5.7	62.6	56.9	− 2.5	54.4	14.8
	5 a. m. to 7 a. m	10,105	.568	5.7	57.4	51.7	− 1.1	50.6	13.8
	Total, 6 hours.	30,315	....	17.1	182.1	165.0	− 3.4	161.6	44.0
	Total, 1 day	116,598	....	71.3	1,780.4	1,709.1	+ .8	1,709.9	466.3

TABLE 118.—*Record of carbon dioxid in ventilating air current, etc.*—Continued.

Date.	Period.	(*a*) Ventilation (number of liters of air).	Carbon dioxid. In coming air. (*b*) Per liter.	(*c*) Total, $a \times b$.	(*d*) In outgoing air.	(*e*) Total excess in outgoing air, $d-c$.	(*f*) Correction for amount remaining in chamber.	(*g*) Corrected amount exhaled by subject, $e+f$.	(*h*) Total weight of carbon exhaled, $g \times \frac{3}{11}$.
1901.	*Experiment No. 46.*	*Liters.*	*Mgs.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
May 3-4	7 a. m. to 9 a. m	9,328	0.558	5.2	108.0	102.8	+70.2	173.0	47.2
	9 a. m. to 11 a. m	9,328	.558	5.2	262.1	256.9	+38.0	294.9	80.4
	11 a. m. to 1 p. m	8,551	.558	4.8	259.4	254.6	−32.8	221.8	60.5
	Total, 6 hours	27,207	....	15.2	629.5	614.3	+75.4	689.7	188.1
	1 p. m. to 3 p. m	9,328	.582	6.4	192.5	186.1	+10.3	196.4	53.6
	3 p. m. to 5 p. m	8,551	.582	5.8	234.4	228.6	+23.0	251.6	68.6
	5 p. m. to 7 p. m	9,328	.582	6.4	282.3	275.9	−30.8	245.1	66.8
	Total, 6 hours	27,207	....	18.6	709.2	690.6	+ 2.5	693.1	189.0
	7 p. m. to 9 p. m	9,328	.628	5.9	150.6	144.7	−54.8	89.9	24.5
	9 p. m. to 11 p. m	9,328	.628	5.9	96.3	90.4	−12.2	78.2	21.3
	11 p. m. to 1 a. m	10,105	.628	6.3	83.1	76.8	−11.1	65.7	17.9
	Total, 6 hours	28,761	....	18.1	330.0	311.9	−78.1	233.8	63.7
	1 a. m. to 3 a. m	9,328	.672	6.3	63.3	57.0	− .2	56.8	15.5
	3 a. m. to 5 a. m	9,328	.672	6.3	60.9	54.6	− 2.9	51.7	14.1
	5 a. m. to 7 a. m	9,328	.672	6.3	58.0	51.7	− .2	51.5	14.0
	Total, 6 hours	27,984	....	18.9	182.2	163.3	− 3.3	160.0	43.6
	Total, 1 day	111,159	....	70.8	1,850.9	1,780.1	− 3.5	1,776.6	484.4
4-5	7 a. m. to 9 a. m	9,328	.634	5.9	104.6	98.7	+70.5	169.2	46.1
	9 a. m. to 11 a. m	8,551	.634	5.4	223.8	218.4	+30.4	248.8	67.9
	11 a. m. to 1 p. m	9,328	.634	5.9	259.0	253.1	−25.7	227.4	62.0
	Total, 6 hours	27,207	....	17.2	587.4	570.2	+75.2	645.4	176.0
	1 p. m. to 3 p. m	8,551	.771	6.6	167.8	161.2	+14.7	175.9	48.0
	3 p. m. to 5 p. m	9,328	.771	7.2	253.7	246.5	+11.7	258.2	70.4
	5 p. m. to 7 p. m	8,551	.771	6.6	233.4	226.8	−34.1	192.7	52.6
	Total, 6 hours	26,430	....	20.4	654.9	634.5	− 7.7	626.8	171.0
	7 p. m. to 9 p. m	9,328	.769	7.2	145.2	138.0	−42.2	95.8	26.1
	9 p. m. to 11 p. m	9,328	.769	7.2	97.8	90.6	− 9.4	81.2	22.1
	11 p. m. to 1 a. m	9,328	.769	7.2	80.6	73.4	−10.8	62.6	17.1
	Total, 6 hours	27,984	....	21.6	323.6	302.0	−62.4	239.6	65.3
	1 a. m. to 3 a. m	9,328	.715	6.7	65.3	58.6	− 3.6	55.0	15.0
	3 a. m. to 5 a. m	9,328	.715	6.7	59.6	52.9	− 0.6	52.3	14.3
	5 a. m. to 7 a. m	9,328	.715	6.7	59.0	52.3	− 1.3	51.0	13.9
	Total, 6 hours	27,984	....	20.1	183.9	163.8	− 5.5	158.3	43.2
	Total, 1 day	109,605	....	79.3	1,749.8	1,670.5	− .4	1,670.1	455.5
5-6	7 a. m. to 9 a. m	9,328	.626	5.8	102.5	96.7	+68.1	164.8	44.9
	9 a. m. to 11 a. m	9,328	.626	5.8	234.0	228.2	+28.0	256.2	69.9
	11 a. m. to 1 p. m	8,551	.626	5.4	233.5	228.1	−21.0	207.1	56.5
	Total, 6 hours	27,207	....	17.0	570.0	553.0	+75.1	628.1	171.3
	1 p. m. to 3 p. m	9,328	.883	8.2	183.8	175.6	+13.7	189.3	51.6
	3 p. m. to 5 p. m	8,551	.883	7.6	231.2	223.6	+17.4	241.0	65.7
	5 p. m. to 7 p. m	9,328	.883	8.2	255.9	247.7	−34.5	213.2	58.1
	Total, 6 hours	27,207	....	24.0	670.9	646.9	− 3.4	643.5	175.4

TABLE 118.—*Record of carbon dioxid in ventilating air current, etc.*—Continued.

Date.	Period.	(*a*) Ventilation (number of liters of air).	Carbon dioxid. In incoming air. (*b*) Per liter.	(*c*) Total, $a \times b$.	(*d*) In outgoing air.	(*e*) Total excess in outgoing air, $d-c$.	(*f*) Correction for amount remaining in chamber.	(*g*) Corrected amount exhaled by subject, $e+f$.	(*h*) Total weight of carbon exhaled, $g \times \frac{3}{11}$.
1901.	*Experiment No. 46*—Continued.	*Liters.*	*Mgs.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
May 5–6	7 p. m. to 9 p. m.	9,328	0.638	6.0	142.1	136.1	−46.2	89.9	24.5
	9 p. m. to 11 p. m.	9,328	.638	6.0	94.8	88.8	− 8.3	80.5	22.0
	11 p. m. to 1 a. m.	9,328	.638	6.0	79.3	73.3	−12.2	61.1	16.7
	Total, 6 hours.	27,984	......	18.0	316.2	298.2	−66.7	231.5	63.2
	1 a. m. to 3 a. m.	9,328	.638	6.0	64.1	58.1	− 3.2	54.9	15.0
	3 a. m. to 5 a. m.	9,328	.638	6.0	60.5	54.5	− 1.2	53.3	14.5
	5 a. m. to 7 a. m.	9,328	.638	6.0	56.7	50.7	− 2.3	48.4	13.2
	Total, 6 hours.	27,984	......	18.0	181.3	163.3	− 6.7	156.6	42.7
	Total, 1 day	110,382	......	77.0	1,738.4	1,661.4	− 1.7	1,659.7	452.6
6–7	7 a. m. to 9 a. m.	9,328	.681	6.4	101.4	95.0	+67.3	162.3	44.3
	9 a. m. to 11 a. m.	8,551	.681	5.8	212.8	207.0	+27.4	234.4	63.9
	11 a. m. to 1 p. m.	9,328	.681	6.4	253.4	247.0	−20.3	226.7	61.8
	Total, 6 hours.	27,207	......	18.6	567.6	549.0	+74.4	623.4	170.0
	1 p. m. to 3 p. m.	9,328	.789	7.4	178.0	170.6	+14.8	185.4	50.6
	3 p. m. to 5 p. m.	8,551	.789	6.7	233.1	226.4	+16.3	242.7	66.2
	5 p. m. to 7 p. m.	8,551	.789	6.7	231.3	224.6	−35.4	189.2	51.6
	Total, 6 hours.	26,430	......	20.8	642.4	621.6	− 4.3	617.3	168.4
	7 p. m. to 9 p. m.	9,328	.644	6.0	145.9	139.9	−40.4	99.5	27.1
	9 p. m. to 11 p. m.	9,328	.644	6.0	103.9	97.9	− 8.8	89.1	24.3
	11 p. m. to 1 a. m.	9,328	.644	6.0	80.9	74.9	−13.9	61.0	16.6
	Total, 6 hours.	27,984	......	18.0	330.7	312.7	−63.1	249.6	68.0
	1 a. m. to 3 a. m.	9,328	.610	5.7	61.4	55.7	− 5.2	50.5	13.8
	3 a. m. to 5 a. m.	9,328	.610	5.7	57.8	52.1	+ .2	52.3	14.3
	5 a. m. to 7 a. m.	9,328	.610	5.7	58.1	52.4	− .5	51.9	14.2
	Total, 6 hours.	27,984	......	17.1	177.3	160.2	− 5.5	154.7	42.3
	Total, 1 day	109,605	......	74.5	1,718.0	1,643.5	+ 1.5	1,645.0	448.7
	Total, 4 days	440,751	......	301.6	7,057.1	6,755.5	− 4.1	6,751.4	1,841.2
	Experiment No. 47.								
7–8	7 a. m. to 9 a. m.	9,328	.714	6.7	99.0	92.3	+73.2	165.5	45.2
	9 a. m. to 11 a. m.	9,328	.714	6.7	258.3	251.6	+52.1	303.7	82.8
	11 a. m. to 1 p. m.	8,551	.714	6.1	269.7	263.6	−37.6	226.0	61.6
	Total, 6 hours.	27,207	......	19.5	627.0	607.5	+87.7	695.2	189.6
	1 p. m. to 3 p. m.	9,328	.883	8.2	198.7	190.5	+13.8	204.3	55.7
	3 p. m. to 5 p. m.	9,328	.883	8.2	279.1	270.9	+20.1	291.0	79.4
	5 p. m. to 7 p. m.	8,551	.883	7.6	257.5	249.9	−39.8	210.1	57.3
	Total, 6 hours.	27,207	......	24.0	735.3	711.3	− 5.9	705.4	192.4
	7 p. m. to 9 p. m.	9,328	.700	6.5	154.2	147.7	−53.3	94.4	25.7
	9 p. m. to 11 p. m.	9,328	.700	6.5	107.5	101.0	− 5.2	95.8	26.1
	11 p. m to 1 a. m.	8,551	.700	6.0	80.7	74.7	−13.5	61.2	16.7
	Total, 6 hours.	27,207	......	19.0	342.4	323.4	−72.0	251.4	68.5

TABLE 118.—*Record of carbon dioxid in ventilating air current, etc.*—Continued.

Date.	Period.	(a) Ventilation (number of liters of air).	Carbon dioxid. In incoming air. (b) Per liter.	(c) Total, $a \times b$.	(d) In outgoing air.	(e) Total excess in outgoing air, $d - c$.	(f) Correction for amount remaining in chamber.	(g) Corrected amount exhaled by subject, $e + f$.	(h) Total weight of carbon exhaled, $g \times \frac{3}{11}$.
	Experiment No. 47—Continued.	*Liters.*	*Mgs.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
1901.									
May 7-8	1 a. m. to 3 a. m	9,328	0.628	5.8	64.9	59.1	− 7.5	51.6	14.1
	3 a. m. to 5 a. m	9,328	.628	5.8	60.1	54.3	− .8	53.5	14.6
	5 a. m. to 7 a. m	9,328	.628	5.8	60.4	54.6	+ .5	55.1	15.0
	Total, 6 hours	27,984	....	17.4	185.4	168.0	− 7.8	160.2	43.7
	Total, 1 day	109,605	....	79.9	1,890.1	1,810.2	+ 2.0	1,812.2	494.2
8-9	7 a. m. to 9 a. m	8,551	.738	6.3	99.5	93.2	+74.8	168.0	45.8
	9 a. m. to 11 a. m	9,528	.738	6.9	270.2	263.3	+40.7	304.0	82.9
	11 a. m. to 1 p. m	8,551	.738	6.3	271.9	265.6	−29.5	236.1	64.4
	Total, 6 hours	26,430	....	19.5	641.6	622.1	+86.0	708.1	193.1
	1 p. m. to 3 p. m	9,328	.836	7.8	205.1	197.3	+13.2	210.5	57.4
	3 p. m. to 5 p. m	8,551	.836	7.1	261.9	254.8	+17.6	272.4	74.3
	5 p. m. to 7 p. m	9,328	.836	7.8	280.2	272.4	−38.5	233.9	63.8
	Total, 6 hours	27,207	....	22.7	747.2	724.5	− 7.7	716.8	195.5
	7 p. m. to 9 p. m	8,551	.705	6.0	142.8	136.8	−49.2	87.6	23.9
	9 p. m. to 11 p. m	9,328	.705	6.6	108.2	101.6	− 9.3	92.3	25.2
	11 p. m. to 1 a. m	9,328	.705	6.6	85.3	78.7	−15.9	62.8	17.1
	Total, 6 hours	27,207	....	19.2	336.3	317.1	−74.4	242.7	66.2
	1 a. m. to 3 a. m	9,328	.671	6.2	61.0	54.8	− 5.4	49.4	13.5
	3 a. m. to 5 a. m	9,328	.671	6.2	57.7	51.5	− .2	51.3	14.0
	5 a. m. to 7 a. m	10,105	.671	6.8	64.4	57.6	+ .8	58.4	15.9
	Total, 6 hours	28,761	....	19.2	183.1	163.9	− 4.8	159.1	43.4
	Total, 1 day	109,605	....	80.6	1,908.2	1,827.6	− .9	1,826.7	498.2
9-10	7 a. m. to 9. a. m	8,551	.853	7.3	101.9	94.6	+85.8	180.4	49.2
	9 a. m. to 11 a. m	9,328	.853	8.0	284.3	276.3	+34.5	310.8	84.8
	11 a. m. to 1 p. m	9,328	.853	8.0	293.7	285.7	−34.7	251.0	68.4
	Total, 6 hours	27,207	....	23.3	679.9	656.6	+85.6	742.2	202.4
	1 p. m. to 3 p. m	8,551	1.063	9.1	178.9	169.8	+ 9.5	179.3	48.9
	3 p. m. to 5 p. m	9,328	1.063	9.9	277.8	267.9	+18.5	286.4	78.1
	5 p. m. to 7 p. m	9,328	1.063	9.9	270.8	260.9	−41.4	219.5	59.9
	Total, 6 hours	27,207	....	28.9	727.5	698.6	−13.4	685.2	186.9
	7 p. m. to 9 p. m	8,551	.994	8.5	141.3	132.8	−37.8	95.0	25.9
	9 p. m. to 11 p. m	9,328	.994	9.3	114.6	105.3	−10.7	94.6	25.8
	11 p. m. to 1 a. m	9,328	.994	9.3	88.9	79.6	−18.6	61.0	16.6
	Total, 6 hours	27,207	....	27.1	344.8	317.7	−67.1	250.6	68.3
	1 a. m. to 3 a. m	9,328	.804	7.5	65.1	57.6	− 2.3	55.3	15.1
	3 a. m. to 5 a. m	10,105	.804	8.1	64.4	56.3	− 5.7	50.6	13.8
	5 a. m. to 7 a. m	9,328	.804	7.5	60.4	52.9	+ 2.3	55.2	15.1
	Total, 6 hours	28,761	....	23.1	189.9	166.8	− 5.7	161.1	44.0
	Total, 1 day	110,382	....	102.4	1,942.1	1,839.7	− .6	1,839.1	501.6

TABLE 118.—*Record of carbon dioxid in ventilating air current, etc.*—Continued.

Date.	Period.	(*a*) Ventilation (number of liters of air).	Carbon dioxid. In incoming air. (*b*) Per liter.	(*c*) Total, $a \times b$.	(*d*) In outgoing air.	(*e*) Total excess in outgoing air, $d-c$.	(*f*) Correction for amount remaining in chamber.	(*g*) Corrected amount exhaled by subject, $e+f$.	(*h*) Total weight of carbon exhaled, $g \times \frac{3}{11}$.
1901.	*Experiment No. 47*—Continued.	*Liters.*	*Mgs.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
May 10–11	7 a. m. to 9 a. m	9,328	0.815	7.6	115.2	107.6	+85.6	193.2	52.7
	9 a. m. to 11 a. m	9,328	.815	7.6	281.1	273.5	+32.0	305.5	83.3
	11 a. m. to 1 p. m	8,551	.815	7.0	277.0	270.0	−29.3	240.7	65.6
	Total, 6 hours	27,207	....	22.2	673.3	651.1	+88.3	739.4	201.6
	1 p. m. to 3 p. m	9,328	.894	8.3	197.6	189.3	+ 6.2	195.5	53.3
	3 p. m. to 5 p. m	8,551	.894	7.6	266.6	259.0	+31.0	290.0	79.1
	5 p. m. to 7 p. m	9,328	.894	8.3	298.9	290.6	−44.8	245.8	67.0
	Total, 6 hours	27,207	....	24.2	763.1	738.9	− 7.6	731.3	199.4
	7 p. m. to 9 p. m	9,328	1.089	10.2	162.6	152.4	−49.1	103.3	28.2
	9 p. m. to 11 p. m	9,328	1.089	10.2	115.5	105.3	− 6.8	98.5	26.9
	11 p. m. to 1 a. m	9,328	1.089	10.2	96.6	86.4	−18.5	67.9	18.5
	Total, 6 hours	27,984	....	30.6	374.7	344.1	−74.4	269.7	73.6
	1 a. m. to 3 a. m	9,328	.892	8.3	64.9	56.6	− 5.5	51.1	13.9
	3 a. m. to 5 a. m	9,328	.892	8.3	62.4	54.1	− 5.9	48.2	13.2
	5 a. m. to 7 a. m	10,105	.892	9.0	66.4	57.4	+ 6.4	63.8	17.4
	Total, 6 hours	28,761	....	25.6	193.7	168.1	− 5.0	163.1	44.5
	Total, 1 day	111,159	....	102.6	2,004.8	1,902.2	+ 1.3	1,903.5	519.1
	Total, 4 days	440,751	....	365.5	7,745.2	7,379.7	+ 1.8	7,381.5	2,013.1
	Experiment No. 48.								
11–12	7 a. m. to 9 a. m	8,551	.708	6.1	101.7	95.6	+69.9	165.5	45.1
	9 a. m. to 11 a. m	8,551	.708	6.1	281.1	275.0	+38.6	313.6	85.5
	11 a. m. to 1 p. m	9,328	.708	6.6	282.5	275.9	−34.8	241.1	65.7
	Total, 6 hours	26,430	....	18.8	665.3	646.5	+73.7	720.2	196.3
	1 p. m. to 3 p. m	8,551	.855	7.3	171.0	163.7	+ 9.3	173.0	47.2
	3 p. m. to 5 p. m	8,551	.855	7.3	240.3	233.0	+18.2	251.2	68.5
	5 p. m. to 7 p. m	9,328	.855	8.0	256.5	248.5	−37.0	211.5	57.7
	Total, 6 hours	26,430	....	22.6	667.8	645.2	− 9.5	635.7	173.4
	7 p. m. to 9 p. m	9,328	.734	6.9	141.2	134.3	−39.4	94.9	25.9
	9 p. m. to 11 p. m	9,328	.734	6.9	98.5	91.7	− 9.3	82.4	22.5
	11 p. m. to 1 a. m	9,328	.734	6.9	82.2	75.3	−11.3	64.0	17.5
	Total, 6 hours	27,984	....	20.7	322.0	301.3	−60.0	241.3	65.9
	1 a. m. to 3 a. m	9,328	.648	6.0	65.4	59.4	− 3.4	56.0	15.3
	3 a. m. to 5 a. m	10,105	.648	6.5	62.9	56.4	− .2	56.2	15.3
	5 a. m. to 7 a. m	9,328	.648	6.0	56.1	50.1	− 1.6	48.5	13.2
	Total, 6 hours	28,761	....	18.5	184.4	165.9	− 5.2	160.7	43.8
	Total, 1 day	109,605	....	80.6	1,839.5	1,758.9	− 1.0	1,757.9	479.4
1902.	*Experiment No. 49.*								
Mar. 27–28	7 a. m. to 9 a. m	9,328	.550	5.1	125.9	120.8	+76.5	197.3	53.8
	9 a. m. to 11 a. m	9,328	.550	5.1	242.2	237.1	+22.6	259.7	70.8
	11 a. m. to 1 p. m	9,328	.550	5.1	251.8	246.7	−18.9	227.8	62.1
	Total, 6 hours	27,984	....	15.3	619.9	604.6	+80.2	684.8	186.7

TABLE 118.—*Record of carbon dioxid in ventilating air current, etc.*—Continued.

Date.	Period.	(*a*) Ventilation (number of liters of air).	Carbon dioxid. In incoming air. (*b*) Per liter.	(*c*) Total, $a \times b$.	(*d*) In outgoing air.	(*e*) Total excess in outgoing air, $d - c$.	(*f*) Correction for amount remaining in chamber.	(*g*) Corrected amount exhaled by subject, $e + f$.	(*h*) Total weight of carbon exhaled, $g \times \frac{3}{11}$.
	Experiment No. 49—Continued.								
1902.		*Liters.*	*Mgs.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
Mar. 27–28	1 p. m. to 3 p. m	9,328	0.521	4.9	197.8	192.9	+ 27.7	220.6	60.2
	3 p. m. to 5 p. m	9,328	.521	4.9	289.7	284.8	+ 31.1	315.9	86.2
	5 p. m. to 7 p. m	9,328	.521	4.9	316.6	311.8	− 48.2	263.6	71.9
	Total, 6 hours	27,984	....	14.7	804.1	789.5	+ 10.6	800.1	218.3
	7 p. m. to 9 p. m	10,883	.542	5.9	190.0	184.1	− 58.8	125.3	34.2
	9 p. m. to 11 p. m	10,105	.542	5.5	119.4	113.9	− 7.2	106.7	29.1
	11 p. m. to 1 a. m	9,328	.542	5.1	89.5	84.5	− 16.3	68.2	18.6
	Total, 6 hours	30,316	....	16.5	398.9	382.5	− 82.3	300.2	81.9
	1 a. m. to 3 a. m	9,328	.540	5.0	65.4	60.3	− 6.4	53.9	14.7
	3 a. m. to 5 a. m	9,328	.540	5.0	62.1	57.0	+ 1.7	58.7	16.0
	5 a. m. to 7 a. m	9,328	.540	5.0	62.8	57.8	....	57.8	15.7
	Total, 6 hours	27,984	....	15.0	190.3	175.1	− 4.7	170.4	46.4
	Total, 1 day	114,268	....	61.5	2,013.2	1,951.7	+ 3.8	1,955.5	533.3
28–29	7 a. m. to 9 a. m	9,328	.584	5.4	114.6	109.2	+ 68.1	177.3	48.3
	9 a. m. to 11 a. m	9,328	.584	5.4	244.5	239.1	+ 37.6	276.7	75.5
	11 a. m. to 1 p. m	9,328	.584	5.4	259.8	254.3	+ 6.7	261.0	71.2
	Total, 6 hours	27,984	....	16.2	618.9	602.6	+112.4	715.0	195.0
	1 p. m. to 3 p. m	9,328	.589	5.5	186.3	180.8	− 19.9	160.9	43.9
	3 p. m. to 5 p. m	9,328	.589	5.5	271.7	266.3	+ 23.8	290.1	79.1
	5 p. m. to 7 p. m	9,328	.589	5.5	260.9	255.4	− 50.5	204.9	55.9
	Total, 6 hours	27,984	....	16.5	718.9	702.5	− 46.6	655.9	178.9
	7 p. m. to 9 p. m	10,105	.542	5.5	169.2	163.7	− 35.7	128.0	34.9
	9 p. m. to 11 p. m	10,105	.542	5.5	112.5	107.0	− 14.6	92.4	25.2
	11 p. m. to 1 a. m	9,328	.542	5.1	83.8	78.7	− 11.1	67.6	18.4
	Total, 6 hours	29,538	....	16.1	365.5	349.4	− 61.4	288.0	78.5
	1 a. m. to 3 a. m	9,328	.577	5.4	67.4	62.0	− 6.4	55.6	15.2
	3 a. m. to 5 a. m	9,328	.577	5.4	60.5	55.1	− 1.0	54.1	14.7
	5 a. m. to 7 a. m	9,328	.577	5.4	61.4	56.0	+ 2.3	58.3	15.9
	Total, 6 hours	27,984	....	16.2	189.3	173.1	− 5.1	168.0	45.8
	Total, 1 day	113,490	....	65.0	1,892.6	1,827.6	− .7	1,826.9	498.2
29–30	7 a. m. to 9 a. m	9,328	.516	5.2	113.5	108.4	+ 81.8	190.2	51.9
	9 a. m. to 11 a. m	8,551	.516	4.7	219.7	214.9	+ 14.2	229.1	62.5
	11 a. m. to 1 p. m	9,328	.516	5.2	250.8	245.6	− 16.9	228.7	62.4
	Total, 6 hours	27,207	....	15.1	584.0	568.9	+ 79.1	648.0	176.8
	1 p. m. to 3 p. m	8,551	.529	4.5	178.3	173.8	+ 9.4	183.2	50.0
	3 p. m. to 5 p. m	8,551	.529	4.5	248.7	244.2	+ 34.6	278.8	76.0
	5 p. m. to 7 p. m	8,551	.529	4.5	269.9	265.3	− 38.0	227.3	62.0
	Total, 6 hours	25,653	....	13.5	696.9	683.3	+ 6.0	689.3	188.0

TABLE 118.—*Record of carbon dioxid in ventilating air current, etc.*—Continued.

Date.	Period.	(*a*) Ventilation (number of liters of air).	Carbon dioxid. In incoming air. (*b*) Per liter.	(*c*) Total, $a \times b$.	(*d*) In outgoing air.	(*e*) Total excess in outgoing air, $d - c$.	(*f*) Correction for amount remaining in chamber.	(*g*) Corrected amount exhaled by subject, $e + f$.	(*h*) Total weight of carbon exhaled, $g \times \frac{3}{11}$.
1902.	*Experiment No. 49*—Continued.	*Liters.*	*Mgs.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
Mar. 29–30	7 p. m. to 9 p. m	8,551	0.506	4.3	170.9	166.6	−45.6	121.0	33.0
	9 p. m. to 11 p. m	10,105	.506	5.1	126.8	121.6	−19.4	102.2	27.9
	11 p. m. to 1 a. m	10,105	.506	5.1	95.8	90.7	−15.4	75.3	20.5
	Total, 6 hours	28,761	....	14.5	393.5	378.9	−80.4	298.5	81.4
	1 a. m. to 3 a. m	9,328	.544	5.1	69.1	64.1	− 3.5	60.6	16.5
	3 a. m. to 5 a. m	10,105	.544	5.5	68.2	62.7	− 1.7	61.0	16.6
	5 a. m. to 7 a. m	9,328	.544	5.1	63.8	58.8	+ 1.7	60.5	16.5
	Total, 6 hours	28,761	....	15.7	201.1	185.6	− 3.5	182.1	49.6
	Total, 1 day	110,382	....	58.8	1,875.5	1,816.7	+ 1.2	1,817.9	495.8
	Total, 3 days	338,140	....	185.3	5,781.3	5,596.0	+ 4.3	5,600.3	1,527.3
	Experiment No. 50.								
30–31	7 a. m. to 9 a. m	10,105	.548	5.5	115.0	109.4	+58.5	167.9	45.8
	9 a. m. to 11 a. m	8,551	.548	4.7	221.6	216.9	+30.6	247.5	67.5
	11 a. m. to 1 p. m	9,328	.548	5.1	255.0	249.9	− .5	249.4	68.0
	Total, 6 hours	27,984	....	15.3	591.6	576.2	+88.6	664.8	181.3
	1 p. m. to 3 p. m	9,328	.552	5.1	175.8	170.7	−24.3	146.3	39.9
	3 p. m. to 5 p. m	9,328	.552	5.1	158.4	153.3	−39.7	113.6	36.0
	5 p. m. to 7 p. m	10,105	.552	5.6	101.7	96.2	−15.5	80.7	22.0
	Total, 6 hours	28,761	....	15.8	435.9	420.2	−79.5	340.6	92.9
	7 p. m. to 9 p. m	10,105	.541	5.5	91.5	86.0	− 5.9	80.1	21.8
	9 p. m. to 11 p. m	9,328	.541	5.1	76.4	71.3	+ 2.3	73.6	20.1
	11 p. m. to 1 a. m	10,105	.541	5.5	72.5	67.1	− 7.5	59.6	16.2
	Total, 6 hours	29,538	....	16.1	240.4	224.4	−11.1	213.3	58.1
	1 a. m. to 3 a. m	9,328	.525	4.9	58.3	53.4	− 2.8	50.6	13.8
	3 a. m. to 5 a. m	9,328	.525	4.9	56.2	51.2	+ .5	51.8	14.1
	5 a. m. to 7 a. m	9,328	.525	4.9	58.4	53.5	....	53.5	14.6
	Total, 6 hours	27,984	....	14.7	172.9	158.1	− 2.3	155.9	42.5
	Total, 1 day	114,267	....	61.9	1,440.8	1,378.9	− 4.3	1,374.6	374.8
	Experiment No. 51.								
31–Apr. 1	7 a. m. to 9 a. m	9,328	.527	4.9	73.2	68.3	+ 4.6	72.9	19.9
	9 a. m. to 11 a. m	9,328	.527	4.9	65.6	60.7	− .8	59.9	16.3
	11 a. m. to 1 p. m	9,328	.527	4.9	62.7	57.8	− .2	57.6	15.7
	Total, 6 hours	27,984	....	14.7	201.5	186.8	+ 3.6	190.4	51.9
	1 p. m. to 3 p. m	9,328	.541	5.1	69.9	64.8	+ 2.0	66.8	18.2
	3 p. m. to 5 p. m	9,328	.541	5.1	64.8	59.8	− 2.6	57.2	15.6
	5 p. m. to 7 p. m	9,328	.541	5.1	65.2	60.1	− 2.0	58.1	15.8
	Total, 6 hours	27,984	....	15.3	199.9	184.7	− 2.6	182.1	49.6
	7 p. m. to 9 p. m	10,105	.540	5.5	70.8	65.4	+ 1.3	66.7	18.2
	9 p. m. to 11 p. m	9,328	.540	5.0	60.4	55.3	+ 1.6	56.9	15.5
	11 p. m. to 1 a. m	10,105	.540	5.5	64.9	59.4	− 4.5	54.9	15.0
	Total, 6 hours	29,538	....	16.0	196.1	180.1	− 1.6	178.5	48.7

TABLE 118.—*Record of carbon dioxid in ventilating air current, etc.*—Continued.

Date.	Period.	(*a*) Ventilation (number of liters of air).	Carbon dioxid. In incoming air. (*b*) Per liter.	(*c*) Total, $a \times b$.	(*d*) In outgoing air.	(*e*) Total excess in outgoing air, $d - c$.	(*f*) Correction for amount remaining in chamber.	(*g*) Corrected amount exhaled by subject, $e + f$.	(*h*) Total weight of carbon exhaled. $g \times \frac{3}{11}$.
	Experiment No. 51— Continued.								
1902.		*Liters.*	*Mgs.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
Mar. 31–Apr. 1.	1 a. m. to 3 a. m	10,105	0.533	5.4	57.5	52.1	− 3.0	49.1	13.4
	3 a. m. to 5 a. m	9,328	.533	5.0	53.8	48.8	+ 2.0	50.8	13.9
	5 a. m. to 7 a. m	9,328	.533	5.0	55.9	51.0	+ .8	51.8	14.1
	Total, 6 hours.	28,761	....	15.4	167.2	151.9	− .2	151.7	41.4
	Total, 1 day ..	114,267	....	61.4	764.7	703.5	− .8	702.7	191.6
Apr. 1–2.......	7 a. m. to 9 a. m	9,328	.525	4.9	68.9	64.0	+ 8.0	72.0	19.6
	9 a. m. to 11 a. m ...	10,105	.525	5.3	72.2	66.9	− 2.9	64.0	17.4
	11 a. m. to 1 p. m ...	9,328	.525	4.9	66.9	62.0	− .2	61.8	16.9
	Total, 6 hours.	28,761	....	15.1	208.0	192.9	+ 4.9	197.8	53.9
	1 p. m. to 3 p. m....	8,551	.520	4.4	61.8	57.3	+ .3	57.6	15.7
	3 p. m. to 5 p. m....	9,328	.520	4.8	63.7	58.9	− 1.9	57.0	15.5
	5 p. m. to 7 p. m....	10,105	.520	5.2	67.2	61.9	+ 1.3	63.2	17.2
	Total, 6 hours.	27,984	....	14.4	192.7	178.1	− .3	177.8	48.4
	7 p. m. to 9 a. m	10,105	.518	5.2	70.6	65.4	− 3.6	61.8	16.9
	9 p. m. to 11 p. m ...	9,328	.518	4.8	57.8	53.0	+ 1.3	54.3	14.8
	11 p. m. to 1 a. m ...	10,105	.518	5.2	62.5	57.3	− 2.8	54.5	14.9
	Total, 6 hours.	29,538	....	15.2	190.9	175.7	− 5.1	170.6	46.6
	1 a. m. to 3 a. m	9,328	.534	5.0	52.4	47.4	− 1.0	46.4	12.7
	3 a. m. to 5 a. m	9,328	.534	5.0	54.5	49.5	+ 1.3	50.8	13.9
	5 a. m. to 7 a. m	10,105	.534	5.4	60.3	54.9	− .3	54.6	14.9
	Total, 6 hours.	28,761	....	15.4	167.2	151.8	0.0	151.8	41.5
	Total, 1 day ..	115,044	....	60.1	758.8	698.5	− .5	698.0	190.4
	Total, 2 days..	229,311	....	121.5	1,523.5	1,402.0	− 1.3	1,400.7	382.0
	Experiment No. 52.								
21–22.......	7 a. m. to 9 a. m	9,328	.675	6.3	102.9	96.6	+55.7	152.3	41.5
	9 a. m. to 11 a. m ...	9,328	.675	6.3	213.4	207.1	+31.5	238.6	65.1
	11 a. m. to 1 p. m ...	9,328	.675	6.3	244.2	237.9	− 5.2	232.7	63.5
	Total, 6 hours.	27,984	....	18.9	560.5	541.6	+82.0	623.6	170.1
	1 p. m. to 3 p. m....	9,328	.620	5.8	186.1	180.3	+ 4.2	184.5	50.3
	3 p. m. to 5 p. m....	9,328	.620	5.8	282.9	277.1	+42.4	319.5	87.1
	5 p. m. to 7 p. m....	9,328	.620	5.8	297.2	291.4	−45.5	245.9	67.1
	Total, 6 hours.	27,984	....	17.4	766.2	748.8	+ 1.1	749.9	204.5
	7 p. m. to 9 p. m....	10,105	.571	5.8	157.5	151.7	−59.6	92.1	25.1
	9 p. m. to 11 p. m ...	10,105	.571	5.8	100.1	94.3	− 8.2	86.1	23.5
	11 p. m. to 1 a. m ...	10,105	.571	5.8	81.4	75.6	−11.4	64.2	17.5
	Total, 6 hours.	30,315	....	17.4	339.0	321.6	−79.2	242.4	66.1
	1 a. m. to 3 a. m	9,328	.575	5.4	62.3	56.9	− 1.0	55.9	15.3
	3 a. m. to 5 a. m	9,328	.575	5.4	58.8	53.4	− 4.2	49.2	13.4
	5 a. m. to 7 a. m	9,328	.575	5.4	57.5	52.1	+ 3.6	55.7	15.2
	Total, 6 hours.	27,984	....	16.2	178.6	162.4	− 1.6	160.8	43.9
	Total, 1 day ..	114,267	....	69.9	1,844.3	1,774.4	+ 2.3	1,776.7	484.6

TABLE 118.—*Record of carbon dioxid in ventilating air current, etc.*—Continued.

Date.	Period.	(*a*) Ventilation (number of liters of air).	Carbon dioxid. In incoming air. (*b*) Per liter.	(*c*) Total, $a \times b$.	(*d*) In outgoing air.	(*e*) Total excess in outgoing air, $d-c$.	(*f*) Correction for amount remaining in chamber.	(*g*) Corrected amount exhaled by subject, $e+f$.	(*h*) Total weight of carbon exhaled, $g \times \frac{3}{11}$.
	Experiment No. 52—Continued.								
1902.		*Liters.*	*Mgs.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
Apr. 22–23.....	7 a. m. to 9 a. m....	9,328	0.613	5.7	106.2	100.5	+ 23.0	123.5	33.7
	9 a. m. to 11 a. m...	9,328	.613	5.7	227.7	222.0	+ 68.6	290.6	79.2
	11 a. m. to 1 p. m...	9,328	.613	5.7	251.3	245.6	− 7.4	238.2	65.0
	Total, 6 hours.	27,984	....	17.1	585.2	568.1	+ 84.2	652.3	177.9
	1 p. m. to 3 p. m....	8,551	.589	5.0	174.5	169.5	− 7.6	161.9	44.2
	3 p. m. to 5 p. m....	9,328	.589	5.5	257.6	252.1	+ 29.3	281.4	76.7
	5 p. m. to 7 p. m....	8,551	.589	5.0	234.2	229.2	− 41.7	187.5	51.1
	Total, 6 hours.	26,430	....	15.5	666.3	650.8	− 20.0	630.8	172.0
	7 p. m. to 9 p. m....	10,105	.582	5.9	151.9	146.0	− 45.0	101.0	27.5
	9 p. m. to 11 p. m...	10,105	.582	5.9	98.3	92.4	− 10.4	82.0	22.4
	11 p. m. to 1 a. m...	9,328	.582	5.4	75.0	69.6	− 5.6	64.0	17.5
	Total, 6 hours.	29,538	....	17.2	325.2	308.0	− 61.0	247.0	67.4
	1 a. m. to 3 a. m....	10,105	.585	5.9	68.3	62.4	− 5.5	56.9	15.5
	3 a. m. to 5 a. m....	9,328	.585	5.5	58.2	52.7	+ .3	53.0	14.5
	5 a. m. to 7 a. m....	9,328	.585	5.5	56.7	51.2	+ .3	51.5	14.0
	Total, 6 hours.	28,761	....	16.9	183.2	166.3	− 4.9	161.4	44.0
	Total, 1 day..	112,713	....	66.7	1,759.9	1,693.2	− 1.7	1,691.5	461.3
23–24.....	7 a. m. to 9 a. m....	9,328	.563	5.3	102.1	96.8	+ 55.9	152.7	41.6
	9 a. m. to 11 a. m...	9,328	.563	5.3	227.6	222.3	+ 35.6	257.9	70.3
	11 a. m. to 1 p. m...	9,328	.563	5.3	252.4	247.1	− 5.2	241.9	66.0
	Total, 6 hours.	27,984	....	15.9	582.1	566.2	+ 86.3	652.5	177.9
	1 p. m. to 3 p. m....	9,328	.554	5.2	177.7	172.5	− 8.0	164.5	44.9
	3 p. m. to 5 p. m....	8,551	.554	4.7	224.8	220.1	+ 21.7	241.8	65.9
	5 p. m. to 7 p. m....	9,328	.554	5.2	260.9	255.7	− 32.0	223.7	61.0
	Total, 6 hours.	27,207	....	15.1	663.4	648.3	− 18.3	630.0	171.8
	7 p. m. to 9 p. m....	10,105	.527	5.3	153.4	148.1	− 45.8	102.3	27.9
	9 p. m. to 11 p. m...	10,105	.527	5.3	98.3	93.0	− 8.5	84.5	23.1
	11 p. m. to 1 a. m...	9,328	.527	4.9	79.9	75.0	− 7.8	67.2	18.3
	Total, 6 hours.	29,538	....	15.5	331.6	316.1	− 62.1	254.0	69.3
	1 a. m. to 3 a. m....	9,328	.529	4.9	64.8	59.9	− 3.6	56.3	15.4
	3 a. m. to 5 a. m....	9,328	.529	4.9	61.6	56.7	− 4.5	52.2	14.2
	5 a. m. to 7 a. m....	10,105	.529	5.3	60.8	55.5	+ 1.4	56.9	15.5
	Total, 6 hours.	28,761	....	15.1	187.2	172.1	− 6.7	165.4	45.1
	Total, 1 day..	113,490	....	61.6	1,764.3	1,702.7	− .8	1,701.9	464.1
	Total, 3 days..	340,470	....	198.2	5,368.5	5,170.3	− .2	5,170.1	1,410.0
	Experiment No. 53.								
24–25.....	7 a. m. to 9 a. m....	9,328	.536	5.0	107.0	102.0	+ 61.0	163.0	44.4
	9 a. m. to 11 a. m...	8,551	.536	4.6	215.2	210.6	+ 34.2	244.8	66.8
	11 a. m. to 1 p. m...	9,328	.536	5.0	273.8	268.8	+ 5.9	274.7	74.9
	Total, 6 hours.	27,207	....	14.6	596.0	581.4	+101.1	682.5	186.1

TABLE 118.—*Record of carbon dioxid in ventilating air current, etc.*—Continued.

Date.	Period.	(a) Ventilation (number of liters of air).	Carbon dioxid. In incoming air. (b) Per liter.	(c) Total, $a \times b$.	(d) In outgoing air.	(e) Total excess in outgoing air, $d - c$.	(f) Correction for amount remaining in chamber.	(g) Corrected amount exhaled by subject, $e + f$.	(h) Total weight of carbon exhaled, $g \times \frac{3}{11}$.
	Experiment No. 53—Continued.								
1902.		*Liters.*	*Mgs.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
Apr. 24–25	1 p. m. to 3 p. m.	8,551	0.539	4.6	180.1	175.5	− 13.6	161.9	44.2
	3 p. m. to 5 p. m.	9,328	.539	5.0	263.2	258.2	+ 22.7	280.9	76.6
	5 p. m. to 7 p. m.	9,328	.539	5.0	276.5	271.5	− 35.0	236.5	64.5
	Total, 6 hours.	27,207	....	14.6	719.8	705.2	− 25.9	679.3	185.3
	7 p. m. to 9 p. m.	9,328	.583	5.4	153.8	148.4	− 44.4	104.0	28.4
	9 p. m. to 11 p. m.	9,328	.583	5.4	108.7	103.3	− 8.0	95.3	26.0
	11 p. m. to 1 a. m.	10,105	.583	5.9	95.2	89.3	− 16.6	72.7	19.8
	Total, 6 hours.	28,761	....	16.7	357.7	341.0	− 69.0	272.0	74.2
	1 a. m. to 3 a. m.	9,328	.563	5.3	64.8	59.5	− 4.7	54.8	14.9
	3 a. m. to 5 a. m.	9,328	.563	5.3	61.0	55.7	+ 1.1	56.8	15.5
	5 a. m. to 7 a. m.	9,328	.563	5.3	60.3	55.0	− .3	54.7	14.9
	Total, 6 hours.	27,984	....	15.9	186.1	170.2	− 3.9	166.3	45.3
	Total, 1 day	111,159	....	61.8	1,859.6	1,797.8	+ 2.3	1,800.1	490.9
25–26	7 a. m. to 9 a. m.	9,328	.546	5.1	109.6	104.5	+ 61.4	165.9	45.2
	9 a. m. to 11 a. m.	9,328	.546	5.1	263.4	258.3	+ 55.6	313.9	85.6
	11 a. m. to 1 p. m.	8,551	.546	4.6	269.7	265.1	− 15.9	249.2	68.0
	Total, 6 hours.	27,207	....	14.8	642.7	627.9	+101.1	729.0	198.8
	1 p. m. to 3 p. m.	9,328	.537	5.0	199.1	194.1	− 11.4	182.7	49.8
	3 p. m. to 5 p. m.	9,328	.537	5.0	286.4	281.4	+ 31.2	312.6	85.2
	5 p. m. to 7 p. m.	9,328	.537	5.0	291.8	286.8	− 48.2	238.6	65.1
	Total, 6 hours.	27,984	....	15.0	777.3	762.3	− 28.4	733.9	200.1
	7 p. m. to 9 p. m.	9,328	.577	5.4	152.7	147.3	− 45.8	101.5	27.7
	9 p. m. to 11 p. m.	10,105	.577	5.8	116.4	110.6	− 6.8	103.8	28.3
	11 p. m. to 1 a. m.	10,105	.577	5.8	92.6	86.8	− 15.0	71.8	19.6
	Total, 6 hours.	29,538	....	17.0	361.7	344.7	− 67.6	277.1	75.6
	1 a. m. to 3 a. m.	9,328	.587	5.5	63.5	58.0	− 5.7	52.3	14.3
	3 a. m. to 5 a. m.	10,105	.587	5.9	64.5	58.6	− 1.0	57.6	15.7
	5 a. m. to 7 a. m.	9,328	.587	5.5	61.8	56.3	+ 2.4	58.7	16.0
	Total, 6 hours.	28,761	....	16.9	189.8	172.9	− 4.3	168.6	46.0
	Total, 1 day	113,490	....	63.7	1,971.5	1,907.8	+ .8	1,908.6	520.5
26–27	7 a. m. to 9 a. m.	9,328	.587	5.5	112.6	107.1	+ 60.8	167.9	45.8
	9 a. m. to 11 a. m.	9,328	.587	5.5	266.0	260.5	+ 42.6	303.1	82.7
	11 a. m. to 1 p. m.	10,105	.587	5.9	310.4	304.5	− 5.3	299.2	81.6
	Total, 6 hours.	28,761	....	16.9	689.0	672.1	+ 98.1	770.2	210.1
	1 p. m. to 3 p. m.	9,328	.556	5.2	202.1	196.9	− 6.6	190.3	51.9
	3 p. m. to 5 p. m.	9,328	.556	5.2	283.9	278.7	+ 31.6	310.3	84.6
	5 p. m. to 7 p. m.	9,328	.556	5.2	279.5	274.3	− 53.5	220.8	60.2
	Total, 6 hours.	27,984	....	15.6	765.5	749.9	− 28.5	721.4	196.7

TABLE 118.—*Record of carbon dioxid in ventilating air current, etc.*—Continued.

Date.	Period.	(*a*) Ventilation (number of liters of air).	Carbon dioxid. In incoming air. (*b*) Per liter.	(*c*) Total, $a \times b$.	(*d*) In outgoing air.	(*e*) Total excess in outgoing air, $d - c$.	(*f*) Correction for amount remaining in chamber.	(*g*) Corrected amount exhaled by subject, $e + f$.	(*h*) Total weight of carbon exhaled, $g \times \frac{3}{11}$.
	Experiment No. 53—Continued.								
1902.		*Liters.*	*Mgs.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
Apr. 26–27	7 p. m. to 9 p. m	9,328	0.554	5.2	152.8	147.6	− 43.5	104.1	28.4
	9 p. m. to 11 p. m	10,105	.554	5.6	115.2	109.6	− 9.8	99.8	27.2
	11 p. m. to 1 a. m	9,328	.554	5.2	86.3	81.1	− 15.0	66.1	18.0
	Total, 6 hours.	28,761	....	16.0	354.3	338.3	− 68.3	270.0	73.6
	1 a. m. to 3 a. m	9,328	.552	5.2	67.2	62.0	+ .2	62.2	17.0
	3 a. m. to 5 a. m	9,328	.552	5.2	67.9	62.7	− .8	61.9	16.9
	5 a. m. to 7 a. m	9,328	.552	5.2	63.3	58.1	− .7	57.4	15.6
	Total, 6 hours.	27,984	....	15.6	198.4	182.8	− 1.3	181.5	49.5
	Total, 1 day	113,490	....	64.1	2,007.2	1,943.1	0.0	1,943.1	529.9
	Total, 3 days	338,139	....	189.6	5,838.3	5,648.7	+ 3.1	5,651.8	1,541.3
	Experiment No. 54.								
27–28	7 a. m. to 9 a. m	9,328	.530	4.9	109.8	104.9	+ 60.0	164.9	45.0
	9 a. m. to 11 a. m	9,328	.530	4.9	245.5	240.6	+ 35.9	276.5	75.4
	11 a. m. to 1 p. m	9,328	.530	4.9	258.3	253.4	− 11.8	241.6	65.9
	Total, 6 hours.	27,984	....	14.7	613.6	598.9	+ 84.1	683.0	186.3
	1 p. m. to 3 p. m	8,551	.552	4.7	164.6	159.9	− 5.0	154.9	42.2
	3 p. m. to 5 p. m	9,328	.552	5.2	262.1	256.9	+ 26.1	283.0	77.2
	5 p. m. to 7 p. m	8,551	.552	4.7	253.1	248.4	− 33.3	215.1	58.7
	Total, 6 hours.	26,430	....	14.6	679.8	665.2	− 12.2	653.0	178.1
	7 p. m. to 9 p. m	9,328	.593	5.5	151.3	145.8	− 47.1	98.7	26.9
	9 p. m. to 11 p. m	10,105	.593	6.0	109.3	103.3	− 12.2	91.1	24.8
	11 p. m. to 1 a. m	9,328	.593	5.5	78.4	72.9	− 9.6	63.3	17.3
	Total, 6 hours.	28,761	....	17.0	339.0	322.0	− 68.9	253.1	69.0
	1 a. m. to 3 a. m	10,105	.579	5.9	69.9	64.0	− 4.4	59.6	16.2
	3 a. m. to 5 a. m	9,328	.579	5.4	59.2	53.8	− 1.7	52.1	14.2
	5 a. m. to 7 a. m	9,328	.579	5.4	60.0	54.6	+ 4.3	58.9	16.1
	Total, 6 hours.	28,761	....	16.7	189.1	172.4	− 1.8	170.6	46.5
	Total, 1 day	111,936	....	63.0	1,821.5	1,758.5	+ 1.2	1,759.7	479.9
28–29	7 a. m. to 9 a. m	10,105	.595	6.0	122.3	116.3	+ 70.2	186.5	50.9
	9 a. m. to 11 a. m	9,328	.595	5.6	256.3	250.7	+ 31.3	282.0	76.9
	11 a. m. to 1 p. m	7,774	.595	4.6	233.6	229.0	+ 7.5	236.5	64.5
	Total, 6 hours.	27,207	....	16.2	612.2	596.0	+109.0	705.0	192.3
	1 p. m. to 3 p. m	9,328	.578	5.4	202.7	197.3	− 26.2	171.1	46.7
	3 p. m. to 5 p. m	9,328	.578	5.4	266.7	261.3	+ 31.4	292.7	79.8
	5 p. m. to 7 p. m	6,996	.578	4.0	225.2	221.2	− 37.5	183.7	50.1
	Total, 6 hours.	25,652	....	14.8	694.6	679.8	− 32.3	647.5	176.6
	7 p. m. to 9 p. m	10,105	.616	6.2	160.8	154.6	− 58.5	96.1	26.2
	9 p. m. to 11 p. m	10,105	.616	6.2	100.8	94.6	− 9.1	85.5	23.3
	11 p. m. to 1 a. m	9,328	.616	5.8	75.0	69.2	− 8.3	60.9	16.6
	Total, 6 hours.	29,538	....	18.2	336.6	318.4	− 75.9	242.5	66.1

TABLE 118.—*Record of carbon dioxid in ventilating air current, etc.*—Continued.

Date.	Period.	(*a*) Ventilation (number of liters of air).	Carbon dioxid. In incoming air. (*b*) Per liter.	(*c*) Total, $a \times b$.	(*d*) In outgoing air.	(*e*) Total excess in outgoing air, $d - c$.	(*f*) Correction for amount remaining in chamber.	(*g*) Corrected amount exhaled by subject, $e + f$.	(*h*) Total weight of carbon exhaled, $g \times \frac{3}{11}$.
1902.	*Experiment No. 54*—Continued.	*Liters.*	*Mgs.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
Apr. 28–29	1 a. m. to 3 a. m	9,328	0.623	5.8	64.4	58.6	− 0.3	58.3	15.9
	3 a. m. to 5 a. m	10,105	.623	6.3	66.6	60.3	− 4.3	56.0	15.3
	5 a. m. to 7 a. m	9,328	.623	5.8	59.5	53.7	+ 1.2	54.9	14.9
	Total, 6 hours	28,761	....	17.9	190.5	172.6	− 3.4	169.2	46.1
	Total, 1 day	111,158	....	67.1	1,833.9	1,766.8	− 2.6	1,764.2	481.1
29–30	7 a. m. to 9 a. m	9,328	.603	5.6	108.3	102.7	+ 66.8	169.5	46.2
	9 a. m. to 11 a. m	9,328	.603	5.6	257.0	251.4	+ 56.7	308.1	84.0
	11 a. m. to 1 p. m	9,328	.603	5.6	275.7	270.1	− 33.9	236.2	64.4
	Total, 6 hours	27,984	....	16.8	641.0	624.2	+ 89.6	713.8	194.6
	1 p. m. to 3 p. m	9,328	.590	5.5	185.4	179.9	− 2.8	177.1	48.3
	3 p. m. to 5 p. m	9,328	.590	5.5	236.1	230.6	+ 5.1	235.7	64.3
	5 p. m. to 7 p. m	9,328	.590	5.5	242.1	236.6	− 30.2	206.4	56.3
	Total, 6 hours	27,984	....	16.5	663.6	647.1	− 27.9	619.2	168.9
	7 p. m. to 9 p. m	10,105	.590	6.0	147.6	141.6	− 38.9	102.7	28.0
	9 p. m. to 11 p. m	9,328	.590	5.5	94.1	88.6	− 9.0	79.6	21.7
	11 p. m. to 1 a. m	9,328	.590	5.5	74.8	69.3	− 10.4	58.9	16.1
	Total, 6 hours	28,761	....	17.0	316.5	299.5	− 58.3	241.2	65.8
	1 a. m. to 3 a. m	10,105	.618	6.2	68.8	62.6	− 3.6	59.0	16.1
	3 a. m. to 5 a. m	9,328	.618	5.8	59.4	53.6	+ .3	53.9	14.7
	5 a. m. to 7 a. m	9,328	.618	5.8	62.5	56.7	+ 3.6	60.3	16.4
	Total, 6 hours	28,761	....	17.8	190.7	172.9	+ .3	173.2	47.2
	Total, 1 day	113,490	....	68.1	1,811.7	1,743.6	+ 3.7	1,747.3	476.5
	Total, 3 days	336,584	....	198.2	5,467.1	5,268.9	+ 2.3	5,271.2	1,437.5
	Experiment No. 55.								
30–May 1	7 a. m. to 9 a. m	9,328	.574	5.4	150.5	145.1	+ 99.4	244.5	66.7
	9 a. m. to 11 a. m	9,328	.574	5.4	308.4	303.0	+ 28.4	331.4	90.4
	11 a. m. to 1 p. m	10,105	.574	5.8	336.9	331.1	0.0	331.1	90.3
	Total, 6 hours	28,761	....	16.6	795.8	779.2	+127.8	907.0	247.4
	1 p. m. to 3 p. m	10,105	.586	5.9	251.9	246.0	− 20.7	225.3	61.4
	3 p. m. to 5 p. m	9,328	.586	5.5	311.2	305.7	+ 14.7	320.4	87.4
	5 p. m. to 7 p. m	10,883	.586	6.4	339.6	333.2	− 57.6	275.6	75.2
	Total, 6 hours	30,316	....	17.8	902.7	884.9	− 63.6	821.3	224.0
	7 p. m. to 9 p. m	10,105	.579	5.9	212.6	206.7	+ 35.6	242.3	66.1
	9 p. m. to 11 p. m	10,883	.579	6.3	319.6	313.3	+ 9.2	322.5	87.9
	11 p. m. to 1 a. m	10,105	.579	5.9	284.7	278.8	− .9	277.9	75.8
	Total, 6 hours	31,093	....	18.1	816.9	798.8	+ 43.9	842.7	229.8
	1 a. m. to 3 a. m	10,105	.572	5.8	177.4	171.6	− 98.5	73.1	20.0
	3 a. m. to 5 a. m	10,883	.572	6.2	117.5	111.3	+ 55.9	167.2	45.6
	5 a. m. to 7 a. m	10,105	.572	5.8	233.8	228.0	+ 34.3	262.3	71.5
	Total, 6 hours	31,093	....	17.8	528.7	510.9	− 8.3	502.6	137.1
	Total, 1 day	121,263	....	70.3	3,044.1	2,973.8	+ 99.8	3,073.6	838.3

TABLE 119.—*Carbon dioxid eliminated from lungs and skin by 2-hour periods, metabolism experiments Nos. 35-55, inclusive.*

Number and kind of experiment.	Day.	7 a. m. to 9 a. m.	9 a. m. to 11 a. m.	11 a. m. to 1 p. m.	Total, 6 hours.	1 p. m. to 3 p. m.	3 p. m. to 5 p. m.	5 p. m. to 7 p. m.	Total, 6 hours.	7 p. m. to 9 p. m.	9 p. m. to 11 p. m.	11 p. m. to 1 a. m.	Total, 6 hours.	1 a. m. to 3 a. m.	3 a. m. to 5 a. m.	5 a. m. to 7 a. m.	Total, 6 hours.	Total, 1 day.
Rest experiments, without food.		*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
No. 36	1	76.4	67.8	58.6	202.8	66.6	59.2	60.2	186.0	63.6	57.6	50.0	171.2	49.0	45.9	56.2	151.1	711.1
No. 39	1	66.5	62.4	51.2	180.1	56.5	54.5	50.0	161.0	65.5	50.8	51.8	168.1	42.4	45.2	52.1	139.7	648.9
No. 42	1	75.1	49.1	52.7	176.9	51.4	50.6	53.7	155.7	51.9	48.0	47.9	147.8	44.6	44.8	49.9	139.3	619.7
No. 51	1	72.9	59.9	57.6	190.4	66.8	57.2	58.2	182.2	66.7	56.9	54.9	178.5	49.1	50.8	51.8	151.7	702.8
No. 51	2	72.1	64.0	61.8	197.9	57.6	57.0	63.2	177.8	61.8	54.3	54.5	170.6	46.4	50.8	54.5	151.7	69.80
Average per day	......	72.5	61.9	59.7	194.1	62.2	57.1	60.7	180.0	64.3	55.6	54.7	174.6	47.7	50.8	53.2	151.7	700.4
Average, Nos. 36, 39, 42, 51	......	72.6	60.6	56.4	189.6	59.8	55.7	57.1	172.6	61.9	53.5	51.8	167.2	46.3	47.5	52.9	146.7	676.1
Rest experiment, with food.																		
No. 35	1	94.0	76.4	67.6	238.0	83.6	73.8	77.1	234.5	74.5	72.8	49.5	196.8	44.4	49.4	48.0	141.8	811.1
No. 35	2	92.5	70.3	69.0	231.8	88.3	69.9	70.8	229.0	59.7	67.8	[a]66.0	193.5	51.9	51.5	50.0	153.4	807.7
No. 35	3	88.1	71.6	60.1	219.8	90.0	66.7	85.5	242.2	76.8	69.7	57.0	203.5	50.1	52.8	52.8	155.7	821.2
No. 35	4	86.3	75.9	69.6	231.8	81.9	73.2	67.3	222.4	59.4	67.7	[a]65.3	192.4	54.5	54.0	53.2	161.7	808.3
Average per day	......	90.2	73.6	66.6	230.4	85.9	70.9	75.2	232.0	67.6	69.5	59.5	196.6	50.2	51.9	51.0	153.1	812.1
Work experiments, conditions exceptional.																		
No. 50	1	167.9	247.5	249.4	664.8	146.3	[b]113.6	80.7	340.6	80.1	73.6	59.6	213.3	50.6	51.8	53.5	155.9	1,374.6
No. 55	1	244.5	331.4	331.1	907.0	225.3	320.4	275.6	821.3	242.3	322.5	277.9	842.7	[c]73.1	167.2	262.3	502.6	3,073.6
Work experiments, carbohydrate diet.																		
No. 37	1	182.5	211.0	185.1	578.6	156.1	238.7	214.7	609.5	106.9	98.8	61.0	266.7	53.4	51.3	51.2	155.9	1,610.7
No. 37	2	189.6	245.1	249.3	684.0	209.5	267.3	207.0	683.8	102.1	84.4	56.1	242.6	48.0	45.4	52.7	146.1	1,756.5

[a] On these nights supper was eaten at 10.45 p. m.
[b] In this experiment the subject stopped work at 3 p. m.
[c] In this experiment the subject was off the bicycle from 1 a. m. to 4.13 a. m.

TABLE 119.—*Carbon dioxid eliminated from lungs and skin by 2-hour periods, metabolism experiments Nos. 35–55, inclusive*—Continued.

Number and kind of experiment.	Day.	7 a. m. to 9 a. m.	9 a. m. to 11 a. m.	11 a. m. to 1 p. m.	Total, 6 hours.	1 p. m. to 3 p. m.	3 p. m. to 5 p. m.	5 p. m. to 7 p. m.	Total, 6 hours.	7 p. m. to 9 p. m.	9 p. m. to 11 p. m.	11 p. m. to 1 a. m.	Total, 6 hours.	1 a. m. to 3 a. m.	3 a. m. to 5 a. m.	5 a. m. to 7 a. m.	Total, 6 hours.	Total, 1 day.
Work experiments, carbohydrate diet—Continued.		*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
No. 37	3	185.0	272.9	244.2	702.1	182.6	232.6	217.9	633.1	85.7	85.0	54.3	225.0	51.0	45.0	49.8	145.8	1,706.0
No. 37	4	160.0	239.6	200.7	600.3	169.1	234.6	177.1	580.8	87.6	82.5	53.8	223.9	50.0	42.7	52.0	144.7	1,549.7
Average per day		179.3	242.1	219.8	641.2	179.3	243.3	204.2	626.8	95.6	87.7	56.3	239.6	50.6	46.1	51.4	148.1	1,655.7
No. 40	1	202.7	299.0	273.3	775.0	218.1	285.9	217.7	721.7	101.3	86.5	59.3	247.1	51.3	50.0	60.3	161.6	1,905.4
No. 40	2	161.1	298.8	235.2	695.1	190.6	302.6	224.1	717.3	103.9	85.0	62.3	251.2	56.3	50.9	50.2	157.4	1,821.0
No. 40	3	180.2	295.5	241.5	717.2	214.7	284.0	209.6	708.3	101.8	85.1	59.8	246.7	51.8	46.5	54.8	153.1	1,825.3
No. 40	4	187.8	293.4	233.7	714.9	196.3	282.8	227.9	707.0	120.3	82.6	63.4	266.3	53.8	53.0	52.6	159.4	1,847.6
Average per day		183.0	296.7	245.9	725.6	204.9	288.8	219.8	713.5	106.8	84.8	61.2	252.8	53.3	50.1	54.5	157.9	1,849.8
No. 44	1	172.2	253.1	218.6	643.9	192.3	270.7	283.4	746.4	101.3	93.1	64.1	258.5	47.6	58.1	51.6	157.3	1,806.1
No. 44	2	158.2	257.4	221.7	637.3	209.3	285.9	244.9	740.1	98.3	99.6	57.4	255.3	47.4	55.0	55.7	158.1	1,790.8
No. 44	3	169.0	265.9	247.4	682.3	210.4	311.2	234.5	756.1	96.6	97.5	57.3	251.4	50.1	54.5	55.6	160.2	1,850.0
No. 44	4	179.8	289.6	252.9	722.3	232.5	296.2	270.7	799.4	114.5	92.2	61.4	268.1	55.6	53.2	55.8	164.6	1,954.4
Average per day		169.8	266.5	235.2	671.5	211.1	291.0	258.4	760.5	102.7	95.6	60.0	258.3	50.2	55.2	54.7	160.1	1,850.4
No. 47	1	165.5	303.7	226.0	695.2	204.3	291.0	210.1	705.4	94.4	95.8	61.2	251.4	51.6	53.5	55.1	160.2	1,812.2
No. 47	2	168.0	304.0	236.1	708.1	210.5	272.4	233.9	716.8	87.6	92.3	62.8	242.7	49.4	51.3	58.4	159.1	1,826.7
No. 47	3	180.4	310.8	251.0	742.2	179.3	286.4	219.5	685.2	95.0	94.6	61.0	250.6	55.3	50.6	55.2	161.1	1,839.1
No. 47	4	193.2	305.5	240.7	739.4	195.5	290.0	245.8	731.3	103.3	98.5	67.9	269.7	51.1	48.2	63.8	163.1	1,903.5
Average per day		176.8	306.0	238.4	721.2	197.4	285.0	227.3	709.7	95.1	95.3	63.2	253.6	51.9	50.9	58.1	160.9	1,845.4
No. 49	1	197.3	259.7	227.7	684.7	220.6	315.9	263.6	800.1	125.3	106.7	68.2	300.2	53.9	58.7	57.8	170.4	1,955.5
No. 49	2	177.3	276.7	261.0	715.0	160.9	290.1	204.9	655.9	128.0	92.4	67.6	288.0	55.6	54.1	58.3	168.0	1,827.0
No. 49	3	190.2	229.1	228.7	648.0	183.2	278.8	227.3	689.3	121.0	102.2	75.3	298.5	60.6	61.0	60.4	182.0	1,817.9
Average per day		188.3	255.2	239.1	682.6	188.2	295.0	231.9	715.1	124.8	100.4	70.4	295.6	56.7	57.9	58.9	173.5	1,866.8

No. 53	1	163.0	244.8	274.7	682.5	161.9	280.9	236.5	679.3	101.0	95.3	72.7	272.0	54.8	56.8	54.7	166.3	1,800.1
No. 53	2	165.9	313.9	249.2	729.0	182.7	312.6	238.6	733.9	101.5	103.8	71.8	277.1	52.3	57.6	58.7	168.6	1,908.6
No. 53	3	167.9	303.1	299.2	770.2	190.3	310.3	220.8	721.4	104.1	99.8	66.1	270.0	62.2	61.9	57.4	181.5	1,943.1
Average per day	......	165.6	287.3	274.4	727.3	178.3	301.3	231.9	711.5	103.2	99.6	70.2	273.0	56.4	58.8	56.9	172.1	1,883.9
Average, Nos. 37, 40, 44, 47	......	177.2	277.8	234.8	689.8	198.2	277.0	227.4	702.6	100.1	90.9	60.1	251.1	51.5	50.6	51.7	156.8	1,800.3
Average, Nos. 49, 53	......	177.0	271.2	256.8	705.0	183.2	298.2	231.9	713.3	114.0	100.0	70.3	284.3	56.6	58.4	57.8	172.8	1,875.4
Average, Nos. 37, 40, 44, 47, 49, 53	......	177.1	276.1	240.8	694.0	194.1	282.8	228.7	705.6	103.8	93.4	62.9	260.1	52.8	52.7	55.6	161.1	1,820.8
Work experiments, fat diet.																		
No. 38	1	169.3	202.7	196.4	568.4	155.9	236.1	176.6	568.6	83.7	74.2	58.5	216.4	50.4	47.9	50.1	148.4	1,501.8
No. 38	2	153.6	221.8	194.4	569.8	175.3	227.4	182.6	585.3	74.6	76.8	57.8	209.2	52.7	46.4	49.7	148.8	1,513.1
No. 38	3	151.9	197.8	181.2	533.9	166.0	204.9	191.4	562.3	82.2	76.1	54.6	212.9	51.3	45.5	49.9	146.7	1,455.8
No. 38	4	139.7	216.2	184.9	540.8	145.2	212.1	177.7	535.0	86.0	69.1	52.6	207.7	52.0	42.0	47.2	141.2	1,424.7
Average, per day	......	154.4	209.6	189.2	553.2	160.6	220.1	182.1	562.8	81.6	74.0	55.9	211.5	51.6	45.5	49.2	146.3	1,473.8
No. 41	1	195.9	278.4	199.6	673.9	211.6	262.6	220.8	695.0	76.7	75.1	64.9	216.7	54.5	52.8	54.9	162.2	1,747.8
No. 41	2	165.9	246.1	228.8	640.8	178.0	250.0	222.3	650.3	77.9	73.2	55.7	206.8	54.6	50.4	53.4	158.4	1,656.3
No. 41	3	178.2	263.4	207.5	649.1	176.1	240.9	213.0	630.0	94.8	77.5	53.1	225.4	51.3	50.9	50.0	152.2	1,656.7
No. 41	4	168.3	291.2	256.3	715.8	193.7	239.4	200.5	633.6	78.1	72.6	66.2	216.9	56.2	41.9	48.7	146.8	1,713.1
Average per day	......	177.1	269.8	223.0	669.9	189.8	248.2	214.2	652.2	81.9	74.6	60.0	216.5	54.2	49.0	51.7	154.9	1,693.5
No. 43	1	164.1	266.6	214.1	644.8	224.9	266.5	226.4	717.8	94.3	84.5	54.3	233.1	54.4	50.0	52.3	156.7	1,752.4
No. 43	2	157.4	291.8	215.6	664.8	171.6	222.8	183.1	577.5	100.2	83.5	57.3	241.0	55.7	52.7	57.7	166.1	1,649.4
No. 43	3	168.8	223.3	202.6	594.7	213.7	213.4	251.1	678.2	67.5	72.6	57.8	197.9	52.2	52.8	49.5	154.5	1,625.3
No. 43	4	163.2	250.7	187.7	601.6	167.1	246.7	197.5	611.3	92.4	87.4	62.6	242.4	50.7	50.1	46.0	146.8	1,602.1
Average per day	......	163.4	258.1	205.0	626.5	194.3	237.4	211.5	646.2	88.6	82.0	58.0	228.6	53.2	51.4	51.4	156.0	1,657.3
No. 45	1	170.1	265.8	243.0	678.9	187.0	251.9	205.2	644.1	87.0	83.7	51.6	225.3	56.6	54.4	50.6	161.6	1,709.9
No. 46	1	173.0	294.9	221.8	689.7	196.4	251.6	245.1	693.1	89.9	78.2	65.7	233.8	56.8	51.7	51.5	160.0	1,776.6
No. 46	2	169.2	248.8	227.4	645.4	175.9	258.2	192.7	626.8	95.8	81.2	62.6	239.6	55.0	52.3	51.0	158.3	1,670.1
No. 46	3	164.8	256.2	207.1	628.1	189.3	241.0	213.2	643.5	89.9	80.5	61.1	231.5	54.9	53.3	48.4	156.6	1,659.7
No. 46	4	162.3	234.4	226.7	623.4	185.4	242.7	189.2	617.3	99.5	89.1	61.0	249.6	50.5	52.3	51.9	154.7	1,645.0
Average per day	......	167.3	258.6	220.7	646.6	186.7	248.4	210.1	645.2	93.8	82.2	62.6	238.6	54.3	52.4	50.7	157.4	1,687.8
No. 48	1	165.5	313.6	241.1	720.2	173.0	251.2	211.5	635.7	94.9	82.4	64.0	241.3	56.0	56.2	48.5	160.7	1,757.9

TABLE 119.—*Carbon dioxid eliminated from lungs and skin by 2-hour periods, metabolism experiments Nos. 35–55, inclusive*—Continued.

Number and kind of experiment.	Day.	7 a.m. to 9 a.m.	9 a.m. to 11 a.m.	11 a.m. to 1 p.m.	Total, 6 hours.	1 p.m. to 3 p.m.	3 p.m. to 5 p.m.	5 p.m. to 7 p.m.	Total, 6 hours.	7 p.m. to 9 p.m.	9 p.m. to 11 p.m.	11 p.m. to 1 a.m.	Total, 6 hours.	1 a.m. to 3 a.m.	3 a.m. to 5 a.m.	5 a.m. to 7 a.m.	Total, 6 hours.	Total, 1 day.
Work experiments, fat diet—Continued.		*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
No. 52	1	152.3	238.6	232.7	623.6	184.5	319.5	245.9	749.9	92.1	86.1	64.2	242.4	55.9	49.2	55.7	160.8	1,776.7
No. 52	2	123.5	290.6	238.2	652.3	161.9	281.4	187.5	630.8	101.0	82.0	64.0	247.0	56.9	53.0	51.5	161.4	1,691.5
No. 52	3	152.7	257.9	241.9	652.5	164.5	241.8	223.7	630.0	102.3	84.5	67.2	254.0	56.3	52.2	56.9	165.4	1,701.9
Average per day	......	142.8	262.4	237.6	642.8	170.3	280.9	219.0	670.2	98.5	84.2	65.1	247.8	56.3	51.5	54.7	162.5	1,723.3
No. 54	1	164.9	276.5	241.6	683.0	154.9	283.0	215.1	653.0	98.7	91.1	63.3	253.1	59.6	52.1	58.9	170.6	1,759.7
No. 54	2	186.5	282.0	236.5	705.0	171.1	292.7	183.7	647.5	96.1	85.5	60.9	242.5	58.3	56.0	54.9	169.2	1,764.2
No. 54	3	169.5	308.1	236.2	713.8	177.1	235.7	206.4	619.2	102.7	79.6	58.9	241.2	59.0	53.9	60.3	173.2	1,747.3
Average per day	......	173.6	288.9	238.1	700.6	167.7	270.5	201.7	639.9	99.2	85.4	61.0	245.6	59.0	54.0	58.0	171.0	1,757.1
Average, Nos. 38, 41, 43. 45, 46, 48	......	165.8	253.5	213.1	632.4	182.6	240.0	205.5	628.1	87.0	78.8	59.1	224.9	53.7	50.2	50.6	154.5	1,639.9
Average, Nos. 52, 54	......	158.2	275.6	237.9	671.7	169.0	275.7	210.4	655.1	98.8	84.8	63.1	246.7	57.7	52.7	56.3	166.7	1,740.2
Average, Nos. 38, 41, 43, 45, 46, 48, 52, 54	......	163.9	259.1	219.3	642.3	179.2	248.9	206.7	634.8	89.9	80.3	60.1	230.3	54.7	50.8	52.1	387.9	1,665.0

TABLE 120.—*Record of water in ventilating air current, metabolism experiments Nos. 35–55, inclusive.*

Date.	Period.	(a) Ventilation (number of liters of air).	Water in incoming air. (b) Per liter.	(c) Total, $a \times b$.	Water in outgoing air. (d) Amount condensed in freezers.	(e) Amount not condensed in freezers.	(f) Total, $d+e$.	(g) Total excess water in outgoing air, $f-c$.	(h) Correction for water remaining in chamber.	(i) Total water of respiration and perspiration, $g+h$.
	Preliminary to experiment No. 35.									
1900.		*Liters.*	*Mgs.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*
Dec. 8–9	7 p. m. to 9 p. m	9,328	0.766	7.1	79.6	15.4	95.0	87.9	+2.3	90.2
	9 p. m. to 11 p. m	10,105	.766	7.7	85.9	15.6	101.5	93.8	−1.0	92.8
	11 p. m. to 1 a. m	9,328	.766	7.1	78.0	14.6	92.6	85.5	+1.0	86.5
	Total, 6 hours	28,761	......	21.9	243.5	45.6	289.1	267.2	+2.3	269.5
	1 a. m. to 3 a. m	10,105	.746	7.5	83.6	15.5	99.1	91.6	−1.7	89.9
	3 a. m. to 5 a. m	10,105	.746	7.5	80.1	16.1	96.2	88.7	− .9	87.8
	5 a. m. to 7 a. m	10,105	.746	7.5	74.9	13.7	88.6	81.1	−6.1	75.0
	Total, 6 hours	30,315	......	22.5	238.6	45.3	283.9	261.4	−8.7	252.7
	Total, ½ day	59,076	......	44.4	482.1	90.9	573.0	528.6	−6.4	522.2
	Experiment No. 35.									
9–10	7 a. m. to 9 a. m	10,105	.757	7.7	84.3	15.2	99.5	91.8	+7.5	99.3
	9 a. m. to 11 a. m	9,328	.757	7.1	82.2	13.2	95.4	88.3	−1.4	86.9
	11 a. m. to 1 p. m	10,105	.757	7.7	76.8	15.2	92.0	84.3	−2.8	81.5
	Total, 6 hours	29,538	......	22.5	243.3	43.6	286.9	264.4	+3.3	267.7
	1 p. m. to 3 p. m	9,328	.791	7.4	76.5	12.9	89.4	82.0	+3.4	85.4
	3 p. m. to 5 p. m	10,105	.791	8.0	79.2	15.3	94.5	86.5	−2.6	83.9
	5 p. m. to 7 p. m	10,105	.791	8.0	79.8	13.8	93.6	85.6	+ .5	86.1
	Total, 6 hours	29,538	......	23.4	235.5	42.0	277.5	254.1	+1.3	255.4
	7 p. m. to 9 p. m	9,328	.707	6.6	73.3	12.8	86.1	79.5	+ .5	80.0
	9 p. m. to 11 p. m	10,105	.707	7.1	79.7	13.1	92.8	85.7	−2.0	83.7
	11 p. m. to 1 a. m	9,328	.707	6.6	68.2	12.1	80.3	73.7	−2.8	70.9
	Total, 6 hours	28,761	......	20.3	221.2	38.0	259.2	238.9	−4.3	234.6
	1 a. m. to 3 a. m	10,105	.645	6.5	70.1	10.9	81.0	74.5	+ .2	74.7
	3 a. m. to 5 a. m	9,328	.645	6.0	48.5	11.6	60.1	54.1	−3.3	50.8
	5 a. m. to 7 a. m	10,105	.645	6.5	66.0	11.4	77.4	70.9	+ .2	71.1
	Total, 6 hours	29,538	......	19.0	184.6	33.9	218.5	199.5	−2.9	196.6
	Total, 1 day	117,375	......	85.2	884.6	157.5	1,042.1	956.9	−2.6	954.3
10–11	7 a. m. to 9 a. m	10,105	.683	6.9	73.6	12.7	86.3	79.4	+5.7	85.1
	9 a. m. to 11 a. m	9,328	.683	6.4	70.3	11.7	82.0	75.6	−5.2	70.4
	11 a. m. to 1 p. m	10,105	.683	6.9	68.2	13.4	81.6	74.7	+ .5	75.2
	Total, 6 hours	29,538	......	20.2	212.1	37.8	249.9	229.7	+1.0	230.7
	1 p. m. to 3 p. m	9,328	.706	6.6	64.0	10.0	74.0	67.4	+7.5	74.9
	3 p. m. to 5 p. m	9,328	.706	6.6	71.6	12.7	84.3	77.7	−4.1	73.6
	5 p. m. to 7 p. m	10,105	.706	7.1	72.6	13.1	85.7	78.6	− .6	78.0
	Total, 6 hours	28,761	......	20.3	208.2	35.8	244.0	223.7	+2.8	226.5

TABLE 120.—*Record of water in ventilating air current, etc.*—Continued.

Date.	Period.	(*a*) Ventilation (number of liters of air).	Water in incoming air. (*b*) Per liter.	(*c*) Total, $a \times b$.	Water in outgoing air. (*d*) Amount condensed in freezers.	(*e*) Amount not condensed in freezers.	(*f*) Total, $d+e$.	(*g*) Total excess water in outgoing air, $f-c$.	(*h*) Correction for water remaining in chamber.	(*i*) Total water of respiration and perspiration, $g+h$.
	Experiment No. 35—Continued.									
1900.		*Liters.*	*Mgs.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*
Dec. 10–11	7 p. m. to 9 p. m.	9,328	0.697	6.5	65.1	12.4	77.5	71.0	−3.0	68.0
	9 p. m. to 11 p. m.	10,105	.697	7.0	64.8	12.8	77.6	70.6	+ .5	71.1
	11 p. m. to 1 a. m.	10,105	.697	7.0	67.6	12.6	80.2	73.2	+ .2	73.4
	Total, 6 hours	29,538	......	20.5	197.5	37.8	235.3	214.8	−2.3	212.5
	1 a. m. to 3 a. m.	9,328	.659	6.1	62.2	11.2	73.4	67.3	−1.2	66.1
	3 a. m. to 5 a. m.	10,105	.659	6.6	63.0	12.3	75.3	68.7	−2.6	66.1
	5 a. m. to 7 a. m.	10,105	.659	6.7	61.5	11.8	73.3	66.6	+1.3	67.9
	Total, 6 hours	29,538	......	19.4	186.7	35.3	222.0	202.6	−2.5	200.1
	Total, 1 day	117,375	......	80.4	804.5	146.7	951.2	870.8	−1.0	869.8
11–12	7 a. m. to 9 a. m.	10,105	.679	6.9	71.4	12.9	84.3	77.4	+5.7	83.1
	9 a. m. to 11 a. m.	9,328	.679	6.3	70.0	11.1	81.1	74.8	−2.9	71.9
	11 a. m. to 1 p. m.	9,328	.679	6.3	59.6	11.3	70.9	64.6	−1.8	62.8
	Total, 6 hours	28,761	......	19.5	201.0	35.3	236.3	216.8	+1.0	217.8
	1 p. m. to 3 p. m.	9,328	.716	6.7	61.3	11.5	72.8	66.1	+4.6	70.7
	3 p. m. to 5 p. m.	9,328	.716	6.7	64.6	12.1	76.7	70.0	−1.3	68.7
	5 p. m. to 7 p. m.	10,105	.716	7.2	74.0	12.7	86.7	79.5	+1.3	80.8
	Total, 6 hours	28,761	......	20.6	199.9	36.3	236.2	215.6	+4.6	220.2
	7 p. m. to 9 p. m.	9,328	.685	6.4	69.3	11.6	80.9	74.5	− .3	74.2
	9 p. m. to 11 p. m.	10,105	.685	6.9	68.9	12.5	81.4	74.5	−3.1	71.4
	11 p. m. to 1 a. m.	9,328	.685	6.4	63.6	11.4	75.0	68.6	− .7	67.9
	Total, 6 hours	28,761	......	19.7	201.8	35.5	237.3	217.6	−4.1	213.5
	1 a. m. to 3 a. m.	10,105	.651	6.6	66.6	11.3	77.9	71.3	−1.6	69.7
	3 a. m. to 5 a. m.	10,105	.651	6.6	63.7	12.1	75.8	69.2	+1.4	70.6
	5 a. m. to 7 a. m.	10,105	.651	6.6	64.4	11.8	76.2	69.6	+1.5	71.1
	Total, 6 hours	30,315	......	19.8	194.7	35.2	229.9	210.1	+1.3	211.4
	Total, 1 day	116,598	......	79.6	797.4	142.3	939.7	860.1	+2.8	862.9
12–13	7 a. m. to 9 a. m.	9,328	.696	6.5	67.7	11.6	79.3	72.8	+1.5	74.3
	9 a. m. to 11 a. m.	8,551	.696	5.9	63.9	10.2	74.1	68.2	+ .5	68.7
	11 a. m. to 1 p. m.	9,328	.696	6.5	65.2	12.0	77.2	70.7	−1.2	69.5
	Total, 6 hours	27,207	......	18.9	196.8	33.8	230.6	211.7	+ .8	212.5
	1 p. m. to 3 p. m.	9,328	.730	6.8	65.9	11.5	77.4	70.6	+1.6	72.2
	3 p. m. to 5 p. m.	9,328	.730	6.8	68.5	12.0	80.5	73.7	−1.1	72.6
	5 p. m. to 7 p. m.	9,328	.730	6.8	67.5	11.6	79.1	72.3	0.0	72.3
	Total, 6 hours	27,984	......	20.4	201.9	35.1	237.0	216.6	+ .5	217.1
	7 p. m. to 9 p. m.	9,328	.699	6.5	61.3	11.5	72.8	66.3	−2.4	63.9
	9 p. m. to 11 p. m.	10,105	.699	7.1	64.8	12.8	77.6	70.5	0.0	70.5
	11 p. m. to 1 a. m.	10,105	.699	7.1	65.5	12.8	78.3	71.2	0.0	71.2
	Total, 6 hours	29,538	......	20.7	191.6	37.1	228.7	208.0	−2.4	205.6

TABLE 120.—*Record of water in ventilating air current, etc.*—Continued.

Date.	Period.	(a) Ventilation (number of liters of air).	Water in incoming air. (b) Per liter.	(c) Total, $a \times b$.	Water in outgoing air. (d) Amount condensed in freezers.	(e) Amount not condensed in freezers.	(f) Total, $d+e$.	(g) Total excess water in outgoing air, $f-c$.	(h) Correction for water remaining in chamber.	(i) Total water of respiration and perspiration, $g+h$.
1900.	*Experiment No. 35*—Continued.	*Liters.*	*Mgs.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*
Dec. 12–13	1 a. m. to 3 a. m	9,328	0.687	6.4	62.3	10.9	73.2	66.8	−0.9	65.9
	3 a. m. to 5 a. m	10,105	.687	6.9	62.8	12.8	75.6	68.7	−1.4	67.3
	5 a. m. to 7 a. m	10,105	.687	6.9	61.7	11.9	73.6	66.7	+1.9	68.6
	Total, 6 hours	29,538	......	20.2	186.8	35.6	222.4	202.2	− .4	201.8
	Total, 1 day	114,267	......	80.2	777.1	141.6	918.7	838.5	−1.5	837.0
	Total, 4 days	465,615	......	325.4	3,263.6	588.1	3,851.7	3,526.3	−2.3	3,524.0
	Experiment No. 36.									
13–14	7 a. m. to 9 a. m	10,105	.724	7.3	67.2	13.2	80.4	73.1	+ .2	73.3
	9 a. m. to 11 a. m	9,328	.724	6.8	58.8	11.6	70.4	63.6	−2.0	61.6
	11 a. m. to 1 p. m	9,328	.724	6.8	55.0	12.0	67.0	60.2	− .6	59.6
	Total, 6 hours	28,761	......	20.9	181.0	36.8	217.8	196.9	−2.4	194.5
	1 p. m. to 3 p. m	9,328	.754	7.0	58.6	11.5	70.1	63.1	+1.3	64.4
	3 p. m. to 5 p. m	9,328	.754	7.0	55.6	11.8	67.4	60.4	−1.1	59.3
	5 p. m. to 7 p. m	9,328	.754	7.0	57.2	11.5	68.7	61.7	+ .9	62.6
	Total, 6 hours	27,984	......	21.0	171.4	34.8	206.2	185.2	+1.1	186.3
	7 p. m. to 9 p. m	10,105	.697	7.0	58.8	12.8	71.6	64.6	− .6	64.0
	9 p. m. to 11 p. m	9,328	.697	6.5	56.6	11.2	67.8	61.3	0.0	61.3
	11 p. m. to 1 a. m	10,105	.697	7.0	61.2	12.2	73.4	66.4	0.0	66.4
	Total, 6 hours	29,538	......	20.5	176.6	36.2	212.8	192.3	− .6	191.7
	1 a. m. to 3 a. m	10,105	.627	6.3	60.1	11.6	71.7	65.4	−1.2	64.2
	3 a. m. to 5 a. m	10,105	.627	6.3	60.9	11.8	72.7	66.4	− .4	66.0
	5 a. m. to 7 a. m	9,647	.627	6.0	58.7	10.3	69.0	63.0	+2.4	65.4
	Total, 6 hours	29,857	......	18.6	179.7	33.7	213.4	194.8	+ .8	195.6
	Total, 1 day	116,140	......	81.0	708.7	141.5	850.2	769.2	−1.1	768.1
1901.	*Preliminary to experiment No. 37.*									
Jan. 10–11	7 p. m. to 9 p. m	10,105	.705	7.1	75.5	18.9	94.4	87.3	+1.5	88.8
	9 p. m. to 11 p. m	9,328	.705	6.6	75.8	15.3	91.1	84.5	−2.3	82.2
	11 p. m. to 1 a. m	10,105	.705	7.1	68.6	15.7	84.3	77.2	−2.3	74.9
	Total, 6 hours	29,538	......	20.8	219.9	49.9	269.8	249.0	−3.1	245.9
	1 a. m. to 3 a. m	10,105	.712	7.2	75.7	14.7	90.4	83.2	+1.0	84.2
	3 a. m. to 5 a. m	10,105	.712	7.2	72.6	15.0	87.6	80.4	+ .3	80.7
	5 a. m. to 7 a. m	10,105	.712	7.2	72.8	13.9	86.7	79.5	+1.3	80.8
	Total, 6 hours	30,315	......	21.6	221.1	43.6	264.7	492.1	+2.6	245.7
	Total, ½ day	59,853	......	42.4	441.0	93.5	534.5	741.1	+5.7	491.6

TABLE 120.—*Record of water in ventilating air current, etc.*—Continued.

Date.	Period.	(a) Ventilation (number of liters of air).	Water in incoming air.		Water in outgoing air.			(g) Total excess water in outgoing air, f—c.	(h) Correction for water remaining in chamber.	(i) Total water of respiration and perspiration, g+h.
			(b) Per liter.	(c) Total, a×b.	(d) Amount condensed in freezers.	(e) Amount not condensed in freezers.	(f) Total, d+e.			
1901.	*Experiment No. 37.*	*Liters.*	*Mgs.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*
Jan. 11–12.....	7 a. m. to 9 a. m ...	10,105	0.814	8.2	88.4	15.4	103.8	95.6	+ 126.6	222.2
	9 a. m. to 11 a. m ..	9,328	.814	7.6	93.5	14.8	108.3	100.7	+ 428.9	529.6
	11 a. m. to 1 p. m ..	10,105	.814	8.2	100.0	17.7	117.7	109.5	+ 228.0	337.5
	Total, 6 hours	29,538	......	24.0	281.9	47.9	329.8	305.8	+ 783.5	1,089.3
	1 p. m. to 3 p. m ...	9,328	.860	8.0	87.7	14.3	102.0	94.0	+ 96.2	190.2
	3 p. m. to 5 p. m ...	9,328	.860	8.0	96.5	14.8	111.3	103.3	+ 291.5	394.8
	5 p. m. to 7 p. m ...	10,105	.860	8.7	106.1	16.3	122.4	113.7	+ 216.3	330.0
	Total, 6 hours	28,761	......	24.7	290.3	45.4	335.7	311.0	+ 604.0	915.0
	7 p. m. to 9 p. m ...	9,328	.782	7.3	87.5	15.0	102.5	95.2	+ 23.4	118.6
	9 p. m. to 11 p. m ..	10,105	.782	7.9	97.2	14.5	111.7	103.8	— 4.0	99.8
	11 p. m. to 1 a. m ..	10,105	.782	7.9	95.0	14.6	109.6	101.7	— 27.9	73.8
	Total, 6 hours	29,538	......	23.1	279.7	44.1	323.8	300.7	— 8.5	292.2
	1 a. m. to 3 a. m ...	10,105	.710	7.2	100.7	13.7	114.4	107.2	— 29.7	77.5
	3 a. m. to 5 a. m ...	10,105	.710	7.2	93.0	14.8	107.8	100.6	— 32.3	68.3
	5 a. m. to 7 a. m ...	9,328	.710	6.6	91.3	12.2	103.5	96.9	— 27.5	69.4
	Total, 6 hours	29,538	......	21.0	285.0	40.7	325.7	304.7	— 89.5	215.2
	Total, 1 day ..	117,375	......	92.8	1,136.9	178.1	1,315.0	1,222.2	+1,289.5	2,511.7
12–13.....	7 a. m. to 9 a. m ...	10,105	.798	8.1	94.4	14.7	109.1	101.0	+ 160.5	261.5
	9 a. m. to 11 a. m ..	9,328	.798	7.4	100.4	13.8	114.2	106.8	+ 353.2	460.0
	11 a. m. to 1 p. m ..	10,105	.798	8.1	111.9	17.6	129.5	121.4	+ 385.9	507.3
	Total, 6 hours	29,538	......	23.6	306.7	46.1	352.8	329.2	+ 899.6	1,228.8
	1 p. m. to 3 p. m ...	9,328	.901	8.4	99.2	14.0	113.2	104.8	+ 251.4	356.2
	3 p. m. to 5 p. m ...	9,328	.901	8.4	103.1	15.7	118.8	110.4	+ 408.6	519.0
	5 p. m. to 7 p. m ...	9,328	.901	8.4	106.6	15.3	121.9	113.5	+ 304.3	417.8
	Total, 6 hours	27,984	......	25.2	308.9	45.0	353.9	328.7	+ 964.3	1,293.0
	7 p. m. to 9 p. m ...	10,105	.760	7.7	101.8	15.1	116.9	109.2	+ 12.7	121.9
	9 p. m. to 11 p. m ..	10,105	.760	7.7	95.9	13.6	109.5	101.8	+ 12.2	114.0
	11 p. m. to 1 a. m ..	10,105	.760	7.7	92.4	14.3	106.7	99.0	— 30.8	68.2
	Total, 6 hours	30,315	......	23.1	290.1	43.0	333.1	310.0	— 5.9	304.1
	1 a. m. to 3 a. m ...	10,105	.716	7.2	96.0	14.2	110.2	103.0	— 34.8	68.2
	3 a. m. to 5 a. m ...	9,328	.716	6.7	88.6	12.9	101.5	94.8	— 32.5	62.3
	5 a. m. to 7 a. m ...	10,105	.716	7.2	90.3	12.7	103.0	95.8	— 27.9	67.9
	Total, 6 hours	29,538	......	21.1	274.9	39.8	314.7	293.6	— 95.2	198.4
	Total, 1 day ..	117,375	......	93.0	1,180.6	173.9	1,354.5	1,261.5	+1,762.8	3,024.3
13–14.....	7 a. m. to 9 a. m ...	10,105	.820	8.3	94.3	14.0	108.3	100.0	+ 162.3	262.3
	9 a. m. to 11 a. m ..	9,328	.820	7.7	97.6	14.3	111.9	104.2	+ 346.8	451.0
	11 a. m. to 1 p. m ..	10,105	.820	8.3	107.8	16.4	124.2	115.9	+ 378.8	494.7
	Total, 6 hours	29,538	......	24.3	299.7	44.7	344.4	320.1	+ 887.9	1,208.0

TABLE 120.—*Record of water in ventilating air current, etc.*—Continued.

Date.	Period.	(a) Ventilation (number of liters of air).	Water in incoming air. (b) Per liter.	(c) Total, $a \times b$.	Water in outgoing air. (d) Amount condensed in freezers.	(e) Amount not condensed in freezers.	(f) Total, $d+e$.	(g) Total excess water in outgoing air, $f-c$.	(h) Correction for water remaining in chamber.	(i) Total water of respiration and perspiration, $g+h$.
	Experiment No. 37—Continued.									
1901.		*Liters.*	*Mgs.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*
Jan. 13–14.....	1 p. m. to 3 p. m ...	9,328	0.867	8.1	93.6	13.0	106.6	98.5	+ 205.1	303.6
	3 p. m. to 5 p. m ...	9,328	.867	8.1	101.6	15.5	117.1	109.0	+ 404.2	513.2
	5 p. m. to 7 p. m ...	10,105	.867	8.8	109.4	16.4	125.8	117.0	+ 236.3	353.3
	Total, 6 hours	28,761	......	25.0	304.6	44.9	349.5	324.5	+ 845.6	1,170.1
	7 p. m. to 9. p. m ..	10,105	.738	7.5	103.0	15.4	118.4	110.9	− 1.5	109.4
	9 p. m. to 11 p. m ..	10,105	.738	7.5	97.7	14.9	112.6	105.1	− 13.0	92.1
	11 p. m. to 1 a. m ..	10,105	.738	7.5	97.4	14.0	111.4	103.9	− 33.8	70.1
	Total, 6 hours	30,315	......	22.5	298.1	44.3	342.4	319.9	− 48.3	271.6
	1 a. m. to 3 a. m ...	10,105	.698	7.1	99.6	13.7	113.3	106.2	− 34.7	71.5
	3 a. m. to 5 a. m ...	9,328	.698	6.5	88.6	12.9	101.5	95.0	− 34.8	60.2
	5 a. m. to 7 a. m ...	10,105	.698	7.1	89.9	13.1	103.0	95.9	− 34.3	61.6
	Total, 6 hours	29,538	......	20.7	278.1	39.7	317.8	297.1	− 103.8	193.3
	Total, 1 day..	118,152	......	92.5	1,180.5	173.6	1,354.1	1,261.6	+1,581.4	2,843.0
14–15.....	7 a. m. to 9 a. m ...	10,105	.733	7.4	90.1	13.0	103.1	95.7	+ 88.2	183.9
	9 a. m. to 11 a. m ..	9,328	.733	6.8	97.1	12.4	109.5	102.7	+ 289.3	392.0
	11 a. m. to 1 p. m ..	9,328	.733	6.8	92.1	14.5	106.6	99.8	+ 234.2	334.0
	Total, 6 hours	28,761	......	21.0	279.3	39.9	319.2	298.2	+ 611.7	909.9
	1 p. m. to 3 p. m ...	9,328	.842	7.9	88.3	13.4	101.7	93.8	+ 143.6	237.4
	3 p. m. to 5 p. m ...	10,105	.842	8.5	106.3	16.2	122.5	114.0	+ 287.0	401.0
	5 p. m. to 7 p. m ...	9,328	.842	7.9	96.6	15.0	111.6	103.7	+ 199.3	303.0
	Total, 6 hours	28,761	......	24.3	291.2	44.6	335.8	311.5	+ 629.9	941.4
	7 p. m. to 9 p. m ...	10,105	.751	7.6	91.1	15.3	106.4	98.8	+ 2.7	101.5
	9 p. m. to 11 p. m ..	10,105	.751	7.6	90.7	14.2	104.9	97.3	− 2.2	95.1
	11 p. m. to 1 a. m ..	10,105	.751	7.6	93.5	13.7	107.2	99.6	− 26.0	73.6
	Total, 6 hours	30,315	......	22.8	275.3	43.2	318.5	295.7	− 25.5	270.2
	1 a. m. to 3 a. m ...	10,105	.678	6.9	91.9	12.9	104.8	97.9	− 35.6	62.3
	3 a. m. to 5 a. m ...	9,328	.678	6.3	88.0	12.8	100.8	94.5	− 34.4	60.1
	5 a. m. to 7 a. m ...	10,105	.678	6.9	90.7	12.9	103.6	96.7	− 29.9	66.8
	Total, 6 hours	29,538	......	20.1	270.6	38.6	309.2	289.1	− 99.9	189.2
	Total, 1 day..	117,375	......	88.2	1,116.4	166.3	1,282.7	1,194.5	+1,116.2	2,310.7
	Total, 4 days.	470,277	......	366.5	4,614.4	691.9	5,306.3	4,939.8	+5,749.9	10,689.7
	Experiment No. 38.									
15–16.....	7 a. m. to 9 a. m ...	10,105	.802	8.1	90.2	13.9	104.1	96.0	+ 67.7	163.7
	9 a. m. to 11 a. m ..	9,328	.802	7.5	89.9	14.1	104.0	96.5	+ 255.6	352.1
	11 a. m. to 1 p. m ..	9,328	.802	7.5	92.9	14.7	107.6	100.1	+ 256.3	356.4
	Total, 6 hours	28,761	......	23.1	273.0	42.7	315.7	292.6	+ 579.6	872.2

TABLE 120.—*Record of water in ventilating air current, etc.*—Continued.

Date.	Period.	(*a*) Ventilation (number of liters of air).	Water in incoming air. (*b*) Per liter.	Water in incoming air. (*c*) Total, *a*×*b*.	Water in outgoing air. (*d*) Amount condensed in freezers.	Water in outgoing air. (*e*) Amount not condensed in freezers.	Water in outgoing air. (*f*) Total, *d*+*e*.	(*g*) Total excess water in outgoing air, *f*−*c*.	(*h*) Correction for water remaining in chamber.	(*i*) Total water of respiration and perspiration, *g*+*h*.
	Experiment No. 38—Continued.									
1901.		*Liters.*	*Mgs.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*
Jan. 15–16.....	1 p. m. to 3 p. m...	9,328	0.852	7.9	87.2	14.2	101.4	93.5	+ 135.2	228.7
	3 p. m. to 5 p. m...	10,105	.852	8.6	103.5	16.0	119.5	110.9	+ 315.7	426.6
	5 p. m. to 7 p. m...	9,328	.852	7.9	100.2	14.4	114.6	106.7	+ 233.0	339.7
	Total, 6 hours	28,761	......	24.4	290.9	44.6	335.5	311.1	+ 683.9	995.0
	7 p. m. to 9 p. m...	10,105	.801	8.1	85.4	17.9	103.3	95.2	+ 11.9	107.1
	9 p. m. to 11 p. m..	10,105	.801	8.1	93.3	14.0	107.3	99.2	− 3.4	95.8
	11 p. m. to 1 a. m..	10,105	.801	8.1	92.3	13.8	106.1	98.0	− 38.4	59.6
	Total, 6 hours	30,315	......	24.3	271.0	45.7	316.7	292.4	− 29.9	262.5
	1 a. m. to 3 a. m...	10,105	.720	7.3	100.4	13.4	113.8	106.5	− 40.5	66.0
	3 a. m. to 5 a. m...	9,328	.720	6.7	93.2	12.9	106.1	99.4	− 42.2	57.2
	5 a. m. to 7 a. m...	10,105	.720	7.3	92.6	13.0	105.6	98.3	− 44.6	53.7
	Total, 6 hours	29,538	......	21.3	286.2	39.3	325.5	304.2	− 127.3	176.9
	Total, 1 day..	117,375	......	93.1	1,121.1	172.3	1,293.4	1,200.3	+1,106.3	2,306.6
16–17.....	7 a. m. to 9 a. m...	10,105	.846	8.6	91.3	15.0	106.3	97.7	+ 101.2	198.9
	9 a. m. to 11 a. m..	9,328	.846	7.9	98.1	14.0	112.1	104.2	+ 319.0	423.2
	11 a. m. to 1 p. m..	9,328	.846	7.9	98.3	15.3	113.6	105.7	+ 282.2	387.9
	Total, 6 hours	28,761	......	24.4	287.7	44.3	332.0	307.6	+ 692.4	1,010.0
	1 p. m. to 3 p. m...	9,328	.915	8.5	94.5	12.9	107.4	98.9	+ 174.7	273.6
	3 p. m. to 5 p. m...	9,328	.915	8.5	100.8	14.7	115.5	107.0	+ 284.3	391.3
	5 p. m. to 7 p. m...	9,328	.915	8.5	96.2	13.0	109.2	100.7	+ 298.1	398.8
	Total, 6 hours	27,984	......	25.5	291.5	40.6	332.1	306.6	+ 757.1	1,063.7
	7 p. m. to 9 p. m...	8,551	.849	7.3	90.4	12.2	102.6	95.3	+ 25.9	121.2
	9 p. m. to 11 p. m..	10,105	.849	8.6	94.6	13.1	107.7	99.1	− 7.5	91.6
	11 p. m. to 1 a. m..	10,105	.849	8.6	97.6	14.8	112.4	103.8	− 12.4	91.4
	Total, 6 hours	28,761	......	24.5	282.6	40.1	322.7	298.2	+ 6.0	304.2
	1 a. m. to 3 a. m...	10,105	.731	7.4	99.6	12.4	112.0	104.6	− 19.2	85.4
	3 a. m. to 5 a. m...	9,328	.731	6.8	91.9	13.3	105.2	98.4	− 15.0	83.4
	5 a. m. to 7 a. m...	10,105	.731	7.4	92.4	12.1	104.5	97.1	− 14.8	82.3
	Total, 6 hours	29,538	......	21.6	283.9	37.8	321.7	300.1	− 49.0	251.1
	Total, 1 day..	115,044	......	96.0	1,145.7	162.8	1,308.5	1,212.5	+1,416.5	2,629.0
17–18.....	7 a. m. to 9 a. m...	10,105	.800	8.1	94.1	14.2	108.3	100.2	+ 91.4	191.6
	9 a. m. to 11 a. m..	9,328	.800	7.5	98.8	13.1	111.9	104.4	+ 276.3	380.7
	11 a. m. to 1 p. m..	9,328	.800	7.5	97.3	14.7	112.0	104.5	+ 273.7	378.2
	Total, 6 hours	28,761	......	23.1	290.2	42.0	332.2	309.1	+ 641.4	950.5
	1 p. m. to 3 p. m...	10,105	.879	8.9	100.0	14.2	114.2	105.3	+ 144.3	249.6
	3 p. m. to 5 p. m...	9,328	.879	8.2	98.5	14.9	113.4	105.2	+ 319.8	425.0
	5 p. m. to 7 p. m...	10,105	.879	8.9	105.3	15.5	120.8	111.9	+ 256.4	368.3
	Total, 6 hours	29,538	......	26.0	303.8	44.6	348.4	322.4	+ 720.5	1,042.9

TABLE 120.—*Record of water in ventilating air current, etc.*—Continued.

Date.	Period.	(a) Ventilation (number of liters of air).	Water in incoming air. (b) Per liter.	(c) Total, $a \times b$.	Water in outgoing air. (d) Amount condensed in freezers.	(e) Amount not condensed in freezers.	(f) Total, $d+e$.	(g) Total excess water in outgoing air, $f-c$.	(h) Correction for water remaining in chamber.	(i) Total water of respiration and perspiration, $g+h$.
	Experiment No. 38—Continued.									
1901.		*Liters.*	*Mgs.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*
Jan. 17–18.....	7 p. m. to 9 p. m...	9,328	0.839	7.8	94.5	13.9	108.4	100.6	+ 16.7	117.3
	9 p. m. to 11 p. m..	10,105	.839	8.5	95.8	12.7	108.5	100.0	− 1.4	98.6
	11 p. m. to 1 a. m..	10,105	.839	8.5	99.1	13.1	112.2	103.7	− 21.1	82.6
	Total, 6 hours	29,538	......	24.8	289.4	39.7	329.1	304.3	− 5.8	298.5
	1 a. m. to 3 a. m...	10,105	.660	6.7	101.8	12.0	113.8	107.1	− 26.0	81.1
	3 a. m. to 5 a. m...	10,105	.660	6.7	93.5	14.1	107.6	100.9	− 27.9	73.0
	5 a. m. to 7 a. m...	10,105	.660	6.7	92.8	12.3	105.1	98.4	− 24.9	73.5
	Total, 6 hours	30,315	......	20.1	288.1	38.4	326.5	306.4	− 78.8	227.6
	Total, 1 day..	118,152	......	94.0	1,171.5	164.7	1,336.2	1,242.2	+1,277.3	2,519.5
18–19.....	7 a. m. to 9 a. m...	9,328	.718	6.7	87.8	12.2	100.0	93.3	+ 104.9	198.2
	9 a. m. to 11 a. m..	10,105	.718	7.3	108.5	13.4	121.9	114.6	+ 278.8	393.4
	11 a. m. to 1 p. m..	10,105	.718	7.3	102.5	16.3	118.8	111.5	+ 243.4	354.9
	Total, 6 hours	29,538	......	21.3	298.8	41.9	340.7	319.4	+ 627.1	946.5
	1 p. m. to 3 p. m...	9,328	.777	7.2	91.4	12.5	103.9	96.7	+ 150.1	246.8
	3 p. m. to 5 p. m...	10,105	.777	7.9	109.5	16.2	125.7	117.8	+ 298.1	415.9
	5 p. m. to 7 p. m...	10,105	.777	7.9	106.4	15.5	121.9	114.0	+ 218.9	332.9
	Total, 6 hours	29,538	......	23.0	307.3	44.2	351.5	328.5	+ 667.1	995.6
	7 p. m. to 9 p. m...	10,105	.680	6.9	92.6	14.4	107.0	100.1	+ 21.5	121.6
	9 p. m. to 11 p. m..	10,105	.680	6.9	92.2	13.1	105.3	98.4	− 8.2	90.2
	11 p. m. to 1 a. m..	9,328	.680	6.3	92.4	12.8	105.2	98.9	− 23.7	75.2
	Total, 6 hours	29,538	......	20.1	277.2	40.3	317.5	297.4	− 10.4	287.0
	1 a. m. to 3 a. m...	10,883	.632	6.9	100.6	13.4	114.0	107.1	− 28.5	78.6
	3 a. m. to 5 a. m...	10,105	.632	6.4	89.7	13.3	103.0	96.6	− 30.1	66.5
	5 a. m. to 7 a. m...	10,105	.632	6.4	89.0	12.2	101.2	94.8	− 25.3	69.5
	Total, 6 hours	31,093	......	19.7	279.3	38.9	318.2	298.5	− 83.9	214.6
	Total, 1 day..	119,707	......	84.1	1,162.6	165.3	1,327.9	1,243.8	+1,199.9	2,443.7
	Total, 4 days.	470,278	......	367.2	4,600.9	665.1	5,266.0	4,898.8	+5,000.0	9,898.8
	Experiment No. 39.									
9–20.....	7 a. m. to 9 a. m...	9,328	.632	5.9	81.1	12.1	93.2	87.3	+ 2.2	89.5
	9 a. m. to 11 a. m..	10,105	.632	6.4	86.9	11.8	98.7	92.3	− 26.8	65.5
	11 a. m. to 1 p. m..	9,328	.632	5.9	71.6	11.5	83.1	77.2	− 24.2	53.0
	Total, 6 hours	28,761	......	18.2	239.6	35.4	275.0	256..8	− 48.8	208.0
	1 p. m. to 3 p. m...	10,105	.636	6.4	84.5	11.3	95.8	89.4	− 21.7	67.7
	3 p. m. to 5 p. m...	10,105	.636	6.4	79.7	12.8	92.5	86.1	− 31.1	55.0
	5 p. m. to 7 p. m...	9,328	.636	5.9	76.1	11.0	87.1	81.2	− 25.6	55.6
	Total, 6 hours	29,538	......	18.7	240.3	35.1	275.4	256.7	− 78.4	178.3

TABLE 120.—*Record of water in ventilating air current, etc.*—Continued.

Date.	Period.	(a) Ventilation (number of liters of air).	Water in incoming air. (b) Per liter.	(c) Total, $a \times b$.	Water in outgoing air. (d) Amount condensed in freezers.	(e) Amount not condensed in freezers.	(f) Total, $d+e$.	(g) Total excess water in outgoing air, $f-c$.	(h) Correction for water remaining in chamber.	(i) Total water of respiration and perspiration, $g+h$.
	Experiment No. 39—Continued.									
1901.		*Liters.*	*Mgs.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*
Jan. 19–20.....	7 p. m. to 9 p. m....	9,328	0.662	6.2	68.4	11.9	80.3	74.1	− 20.9	53.2
	9 p. m. to 11 p. m...	9,328	.662	6.2	78.0	11.3	89.3	83.1	− 14.0	69.1
	11 p. m. to 1 a. m...	10,105	.662	6.7	78.1	13.5	91.6	84.9	− 10.1	74.8
	Total, 6 hours	28,761	......	19.1	224.5	36.7	261.2	242.1	− 45.0	197.1
	1 a. m. to 3 a. m....	10,105	.626	6.3	80.8	13.0	93.8	87.5	− 3.2	84.3
	3 a. m. to 5 a. m....	10,105	.626	6.3	75.1	13.1	88.2	81.9	− 6.3	75.6
	5 a. m. to 7 a. m....	10,105	.626	6.3	74.2	12.3	86.5	80.2	− 1.2	79.0
	Total, 6 hours	30,315	......	18.9	230.1	38.4	268.5	249.6	− 10.7	238.9
	Total, 1 day..	117,375	......	74.9	934.5	145.6	1,080.1	1,005.2	− 182.9	822.3
	Preliminary to experiment No. 40.									
Feb. 25–26.....	7 p. m. to 9 p. m....	10,105	.625	6.3	75.6	16.1	91.7	85.4	− .8	84.6
	9 p. m. to 11 p. m...	9,328	.625	5.8	72.0	12.7	84.7	78.9	− 1.9	77.0
	11 p. m to 1 a. m....	10,105	.625	6.3	79.0	13.6	92.6	86.3	+ 5.2	91.5
	Total, 6 hours	29,538	......	18.4	226.6	42.4	269.0	250.6	+ 2.5	253.1
	1 a. m. to 3 a. m....	10,105	.597	6.0	81.4	13.3	94.7	88.7	− 2.5	86.2
	3 a. m. to 5 a. m....	10,105	.597	6.0	77.8	13.4	91.2	85.2	− 1.9	83.3
	5 a. m. to 7 a. m....	10,105	.597	6.0	78.9	12.5	91.4	85.4	− 1.5	83.9
	Total, 6 hours	30,315	......	18.0	238.1	39.2	277.3	259.3	− 5.9	253.4
	Total, ½ day .	59,853	......	36.4	464.7	81.6	546.3	509.9	− 3.4	506.5
	Experiment No. 40.									
26–27.....	7 a. m. to 9 a. m....	10,105	.711	7.2	84.2	13.4	97.6	90.4	+ 180.1	270.5
	9 a. m. to 11 a. m...	9,328	.711	6.6	96.1	13.8	109.9	103.3	+ 439.7	543.0
	11 a. m. to 1 p. m...	10,105	.711	7.2	104.3	16.7	121.0	113.8	+ 427.1	540.9
	Total, 6 hours	29,538	......	21.0	284.6	43.9	328.5	307.5	+1,046.9	1,354.4
	1 p. m. to 3 p. m....	9,328	.752	7.0	96.6	13.0	109.6	102.6	+ 269.3	371.9
	3 p. m. to 5 p. m....	9.328	.752	7.0	99.7	15.3	115.0	108.0	+ 464.0	572.0
	5 p. m. to 7 p. m....	10,105	.752	7.6	104.6	15.0	119.6	112.0	+ 309.3	421.3
	Total, 6 hours	28,761	......	21.6	300.9	43.3	344.2	322.6	+1,032.6	1,365.2
	7 p. m. to 9 p. m....	10,105	.645	6.5	91.5	15.1	106.6	100.1	+ 9.0	109.1
	9 p. m. to 11 p. m...	10,105	.645	6.5	89.9	14.1	104.0	97.5	+ 4.2	101.7
	11 p. m. to 1 a. m...	10,105	.645	6.5	92.9	14.4	107.3	100.8	− 8.8	92.0
	Total, 6 hours	30,315	......	19.5	274.3	43.6	317.9	298.4	+ 4.4	302.8
	1 a. m. to 3 a. m....	10,105	.624	6.3	96.2	13.7	109.9	103.6	− 16.8	86.8
	3 a. m. to 5 a. m....	10,105	.624	6.3	89.7	14.9	104.6	98.3	− 14.6	83.7
	5 a. m. to 7 a. m....	10,883	.624	6.8	93.0	14.3	107.3	100.5	− 14.7	85.8
	Total, 6 hours	31,093	......	19.4	278.9	42.9	321.8	302.4	− 46.1	256.3
	Total, 1 day..	119,707	......	81.5	1,138.7	173.7	1,312.4	1,230.9	+2,047.8	3,278.7

TABLE 120.—*Record of water in ventilating air current, etc.*—Continued.

Date.	Period.	(a) Ventilation (number of liters o fair).	Water in incoming air. (b) Per liter.	(c) Total, a×b.	Water in outgoing air. (d) Amount condensed in freezers.	(e) Amount not condensed in freezers.	(f) Total, d+e.	(g) Total excess water in outgoing air, f−c.	(h) Correction for water remaining in chamber.	(i) Total water of respiration and perspiration, g+h.
1901.	*Experiment No. 40*—Continued.	*Liters.*	*Mgs.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*
Feb. 27–28	7 a. m. to 9 a. m ...	9,328	0.706	6.6	92.1	13.0	105.1	98.5	+ 128.0	226.5
	9 a. m. to 11 a. m ..	10,105	.706	7.1	102.7	15.2	117.9	110.8	+ 405.6	516.4
	11 a. m. to 1 p. m ..	9,328	.706	6.6	94.1	15.7	109.8	103.2	+ 374.1	477.3
	Total, 6 hours	28,761	......	20.3	288.9	43.9	332.8	312.5	+ 907.7	1,220.2
	1 p. m. to 3 p. m ...	9,328	.789	7.4	89.4	13.7	103.1	95.7	+ 220.9	316.6
	3 p. m. to 5 p. m ...	10,105	.789	8.0	106.3	17.4	123.7	115.7	+ 449.3	565.0
	5 p. m. to 7 p. m ...	9,328	.789	7.4	107.4	15.1	122.5	115.1	+ 351.1	466.2
	Total, 6 hours	28,761	......	22.8	303.1	46.2	349.3	326.5	+1,021.3	1,347.8
	7 p. m. to 9 p. m ...	10,105	.674	6.8	94.3	15.4	109.7	102.9	− 6.8	96.1
	9 p. m. to 11 p. m ..	10,105	.674	6.8	89.2	14.6	103.8	97.0	+ 46.3	143.3
	11 p. m. to 1 a. m ..	10,105	.674	6.8	93.8	13.9	107.7	100.9	− 20.3	80.6
	Total, 6 hours	30,315	......	20.4	277.3	43.9	321.2	300.8	+ 19.2	320.0
	1 a. m. to 3 a. m ...	10,883	.630	6.9	92.1	15.2	107.3	100.4	− 29.7	70.7
	3 a. m. to 5 a. m ...	10,105	.630	6.4	86.9	14.2	101.1	94.7	− 27.8	66.9
	5 a. m. to 7 a. m ...	10,105	.630	6.4	85.6	13.1	89.7	92.3	− 30.3	62.0
	Total, 6 hours	31,093	......	19.7	264.6	42.5	307.1	287.4	− 87.8	199.6
	Total, 1 day ..	118,930	......	83.2	1,133.9	176.5	1,310.4	1,227.2	+1,860.4	3,087.6
28–Mar. 1.	7 a. m. to 9 a. m ...	9,328	.700	6.5	84.2	12.4	96.6	90.1	+ 158.8	248.9
	9 a. m. to 11 a. m ..	9,328	.700	6.5	97.3	13.0	110.3	103.8	+ 442.3	546.1
	11 a. m. to 1 p. m ..	9,328	.700	6.5	95.5	14.5	110.0	103.5	+ 361.2	464.7
	Total, 6 hours	27,984	......	19.5	277.0	39.9	316.9	297.4	+ 962.3	1,259.7
	1 p. m. to 3 p. m ...	10,105	.782	7.9	100.1	13.8	113.9	106.0	+ 214.6	320.6
	3 p. m. to 5 p. m ...	9,328	.782	7.3	97.6	14.2	111.8	104.5	+ 417.0	521.5
	5 p. m. to 7 p. m ...	9,328	.782	7.3	101.6	13.9	115.5	108.2	+ 317.0	425.2
	Total, 6 hours	28,761	......	22.5	299.3	41.9	341.2	318.7	+ 948.6	1,267.3
	7 p. m. to 9 p. m ...	10,105	.663	6.7	96.9	15.5	112.4	105.7	+ 1.5	107.2
	9 p. m. to 11 p. m ..	10,105	.663	6.7	88.8	13.9	102.7	96.0	+ 12.7	108.7
	11 p. m. to 1 a. m ..	10,105	.663	6.7	91.4	13.7	105.1	98.4	− 18.7	79.7
	Total, 6 hours	30,315	......	20.1	277.1	43.1	320.2	300.1	− 4.5	295.6
	1 a. m. to 3 a. m ...	10,105	.652	6.6	94.8	13.4	108.2	101.6	− 23.0	78.6
	3 a. m. to 5 a. m ...	10,105	.652	6.6	86.5	14.4	100.9	94.3	− 25.2	69.1
	5 a. m. to 7 a. m ...	10,105	.652	6.6	85.4	13.5	98.9	92.3	− 20.5	71.8
	Total, 6 hours	30,315	......	19.8	266.7	41.3	308.0	288.2	− 86.7	219.5
	Total, 1 day ..	117,375	......	81.9	1,120.1	166.2	1,286.3	1,204.4	+1,837.7	3,042.1
Mar. 1–2	7 a. m. to 9 a. m ...	10,105	.802	8.1	87.4	14.8	102.2	94.1	+ 144.6	238.7
	9 a. m. to 11 a. m ..	9,328	.802	7.5	95.9	15.0	110.9	103.4	+ 406.9	520.3
	11 a. m. to 1 p. m ..	8,551	.802	6.9	90.3	14.2	104.5	97.6	+ 394.1	491.7
	Total, 6 hours	27,984	......	22.5	273.6	44.0	317.6	295.1	+ 955.6	1,250.7

TABLE 120.—*Record of water in ventilating air current, etc.*—Continued.

Date.	Period.	(a) Ventilation (number of liters of air).	Water in incoming air. (b) Per liter.	(c) Total, $a \times b$.	Water in outgoing air. (d) Amount condensed in freezers.	(e) Amount not condensed in freezers.	(f) Total, $d+e$.	(g) Total excess water in outgoing air, $f-c$.	(h) Correction for water remaining in chamber.	(i) Total water of respiration and perspiration, $g+h$.
	Experiment No. 40—Continued.									
1901.		*Liters.*	*Mgs.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*
Mar. 1–2	1 p. m. to 3 p. m	9,328	0.839	7.8	90.7	13.4	104.1	96.3	+ 180.6	276.9
	3 p. m. to 5 p. m	9,328	.839	7.8	98.6	15.1	113.7	105.9	+ 443.1	549.0
	5 p. m. to 7 p. m	9,328	.839	7.8	106.3	15.1	121.4	113.6	+ 370.8	484.4
	Total, 6 hours	27,984	......	23.4	295.6	43.6	339.2	315.8	+ 994.5	1,310.3
	7 p. m. to 9 p. m	10,883	.740	8.1	92.5	16.0	108.5	100.4	+ 7.3	107.7
	9 p. m. to 11 p. m	9,328	.740	6.9	87.8	13.3	101.1	94.2	+ 12.2	106.4
	11 p. m. to 1 a. m	10,105	.740	7.5	94.5	14.4	108.9	101.4	− 21.6	79.8
	Total, 6 hours	30,316	......	22.5	274.8	43.7	318.5	296.0	− 2.1	293.9
	1 a. m. to 3 a. m	10,105	.726	7.3	94.5	13.2	107.7	100.4	− 26.5	73.9
	3 a. m. to 5 a. m	10,105	.726	7.3	92.7	13.7	106.4	99.1	− 27.8	71.3
	5 a. m. to 7 a. m	10,105	.726	7.3	91.3	13.2	104.5	97.2	− 29.1	68.1
	Total, 6 hours	30,315	......	21.9	278.5	40.1	318.6	296.7	− 83.4	213.3
	Total, 1 day	116,599	......	90.3	1,122.5	171.4	1,293.9	1,203.6	+1,864.6	3,068.2
	Total, 4 days	472,611	......	336.9	4,515.2	687.8	5,203.0	4,866.1	+7,610.5	12,476.6
	Experiment No. 41.									
2–3	7 a. m. to 9 a. m	10,105	.856	8.7	92.9	14.2	107.1	98.4	+ 160.9	259.3
	9 a. m. to 11 a. m	9,328	.856	8.0	98.1	15.0	113.1	105.1	+ 462.4	567.5
	11 a. m. to 1 p. m	8,551	.856	7.3	90.5	13.7	104.2	96.9	+ 363.3	460.2
	Total, 6 hours	27,984	......	24.0	281.5	42.9	324.4	300.4	+ 986.6	1,287.0
	1 p. m. to 3 p. m	10,105	.842	8.5	100.4	14.6	115.0	106.5	+ 225.1	331.6
	3 p. m. to 5 p. m	9,328	.842	7.9	101.7	14.8	116.5	108.6	+ 469.7	578.3
	5 p. m. to 7 p. m	10,105	.842	8.5	107.2	15.0	122.2	113.7	+ 346.5	460.2
	Total, 6 hours	29,538	......	24.9	309.3	44.4	353.7	328.8	+1,041.3	1,370.1
	7 p. m. to 9 p. m	9,328	.751	7.0	94.1	14.8	108.9	101.9	+ 27.9	129.8
	9 p. m. to 11 p. m	10,105	.751	7.6	92.3	14.8	107.1	99.5	+ 18.7	118.2
	11 p. m. to 1 a. m	10,105	.751	7.6	100.0	14.5	114.5	106.9	− 16.0	90.9
	Total, 6 hours	29,538	......	22.2	286.4	44.1	330.5	308.3	+ 30.6	338.9
	1 a. m. to 3 a. m	10,105	.660	6.7	94.9	13.8	108.7	102.0	− 23.3	78.7
	3 a. m. to 5 a. m	10,105	.660	6.7	94.0	13.8	107.8	101.1	− 21.3	79.8
	5 a. m. to 7 a. m	10,105	.660	6.7	96.0	12.8	108.8	102.1	− 22.8	79.3
	Total, 6 hours	30,315	......	20.1	284.9	40.4	325.3	305.2	− 67.4	237.8
	Total, 1 day	117,375	......	91.2	1,162.1	171.8	1,333.9	1,242.7	+1,991.1	3,233.8
3–4	7 a. m. to 9 a. m	10,105	.740	7.5	94.4	14.0	108.4	100 9	+ 154.9	255.8
	9 a. m. to 11 a. m	9,328	.740	6.9	98.8	14.5	113.3	106.4	+ 422.3	528.7
	11 a. m. to 1 p. m	10,105	.740	7.5	107.3	15.6	122.9	115.4	+ 382.3	497.7
	Total, 6 hours	29,538	......	21.9	300.5	44.1	344.6	322.7	+ 959.5	1,282.2

TABLE 120.—*Record of water in ventilating air current, etc.*—Continued.

Date.	Period.	(a) Ventilation (number of liters of air).	Water in incoming air. (b) Per liter.	(c) Total, a×b.	Water in outgoing air. (d) Amount condensed in freezers.	(e) Amount not condensed in freezers.	(f) Total, d+e.	(g) Total excess water in outgoing air, f−c.	(h) Correction for water remaining in chamber.	(i) Total water of respiration and perspiration, g+h.
	Experiment No. 41—Continued.									
1901.		*Liters.*	*Mgs.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*
Mar. 3–4	1 p. m. to 3 p. m.	9,328	0.758	7.1	94.0	13.0	107.0	99.9	+ 202.0	301.9
	3 p. m. to 5 p. m.	9,328	.758	7.1	103.1	14.6	117.7	110.6	+ 438.6	549.2
	5 p. m. to 7 p. m.	10,105	.758	7.7	108.6	15.4	124.0	116.3	+ 352.4	468.7
	Total, 6 hours	28,761	......	21.9	305.7	43.0	348.7	326.8	+ 993.0	1,319.8
	7 p. m. to 9 p. m.	9,328	.720	6.7	93.6	12.8	106.4	99.7	+ 21.8	121.5
	9 p. m. to 11 p. m.	10,105	.720	7.3	89.1	13.5	102.6	95.3	+ 10.4	105.7
	11 p. m. to 1 a. m.	9,328	.720	6.7	92.5	13.6	106.1	99.4	− 20.9	78.5
	Total, 6 hours	28,761	......	20.7	275.2	39.9	315.1	294.4	+ 11.3	305.7
	1 a. m. to 3 a. m.	10,105	.721	7.3	91.7	14.1	105.8	98.5	− 20.2	78.3
	3 a. m. to 5 a. m.	10,105	.721	7.3	91.3	14.7	106.0	98.7	− 26.9	71.8
	5 a. m. to 7 a. m.	9,328	.721	6.7	92.8	12.7	105.5	98.8	− 22.2	76.6
	Total, 6 hours	29,538	......	21.3	275.8	41.5	317.3	296.0	− 69.3	226.7
	Total, 1 day	116,598	......	85.8	1,157.2	168.5	1,325.7	1,239.9	+1,894.5	3,134.4
4–5	7 a. m. to 9 a. m.	10,105	.858	8.7	91.5	15.2	106.7	98.0	+ 330.3	428.3
	9 a. m. to 11 a. m.	9,328	.858	8.0	101.1	15.0	116.1	108.1	+ 480.7	588.8
	11 a. m. to 1 p. m.	9,328	.858	8.0	97.4	15.8	113.2	105.2	+ 385.5	490.7
	Total, 6 hours	28,761	......	24.7	290.0	46.0	336.0	311.3	+1,196.5	1,507.8
	1 p. m. to 3 p. m.	9,328	.805	7.5	92.9	13.6	106.5	99.0	+ 188.5	287.5
	3 p. m. to 5 p. m.	9,328	.805	7.5	98.1	14.6	112.7	105.2	+ 423.0	528.2
	5 p. m. to 7 p. m.	10,105	.805	8.1	110.5	16.1	126.6	118.5	+ 341.7	460.2
	Total, 6 hours	28,761	......	23.1	301.5	44.3	345.8	322.7	+ 953.2	1,275.9
	7 p. m. to 9 p. m.	10,105	.741	7.5	89.3	15.2	104.5	97.0	+ 23.3	120.3
	9 p. m. to 11 p. m.	10,105	.741	7.5	94.1	13.0	107.1	99.6	+ 24.1	123.7
	11 p. m. to 1 a. m.	9,328	.741	6.9	92.6	12.4	105.0	98.1	− 19.0	79.1
	Total, 6 hours	29,538	......	21.9	276.0	40.6	316.6	294.7	+ 28.4	323.1
	1 a. m. to 3 a. m.	10,105	.738	7.5	101.0	13.5	114.5	107.0	− 24.3	82.7
	3 a. m. to 5 a. m.	10,105	.738	7.5	90.0	14.4	104.4	96.9	− 24.3	72.6
	5 a. m. to 7 a. m.	10,105	.738	7.5	95.3	13.1	108.4	100.9	− 22.7	78.2
	Total, 6 hours	30,315	......	22.5	286.3	41.0	327.3	304.8	− 71.3	233.5
	Total, 1 day	117,375	......	92.2	1,153.8	171.9	1,325.7	1,233.5	+2,106.8	3,340.3
5–6	7 a. m. to 9 a. m.	9,328	.955	8.9	86.9	12.7	99.6	90.7	+ 231.8	322.5
	9 a. m. to 11 a. m.	9,328	.955	8.9	106.6	14.7	121.3	112.4	+ 534.6	647.0
	11 a. m. to 1 p. m.	9,328	.955	8.9	106.5	16.0	122.5	113.6	+ 530.7	644.3
	Total, 6 hours	27,984	......	26.7	300.0	43.4	343.4	316.7	+1,297.1	1,613.8
	1 p. m. to 3 p. m.	9,328	.769	7.2	100.1	13.3	113.4	106.2	+ 228.7	334.9
	3 p. m. to 5 p. m.	8,551	.769	6.6	92.1	12.8	104.9	98.3	+ 445.2	543.5
	5 p. m. to 7 p. m.	10,105	.769	7.8	107.5	14.3	121.8	114.0	+ 296.2	410.2
	Total, 6 hours	27,984	......	21.6	299.7	40.4	340.1	318.5	+ 970.1	1,288.6

TABLE 120.—*Record of water in ventilating air current, etc.*—Continued.

Date.	Period.	(*a*) Ventilation (number of liters of air.)	Water in incoming air. (*b*) Per liter.	(*c*) Total, *a*×*b*.	Water in outgoing air. (*d*) Amount condensed in freezers.	(*e*) Amount not condensed in freezers.	(*f*) Total, *d*+*e*.	(*g*) Total excess water in outgoing air, *f*—*c*.	(*h*) Correction for water remaining in chamber.	(*i*) Total water of respiration and perspiration, *g*+*h*.
1901.	*Experiment No. 41*—Continued.	*Liters*	*Mgs.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*
Mar. 5–6.......	7 p. m. to 9 p. m...	9,328	0.683	6.4	97.1	13.6	110.7	104.3	+ 30.1	134.4
	9 p. m. to 11 p. m..	10,105	.683	6.9	93.6	13.2	106.8	99.9	+ 11.9	111.8
	11 p. m to 1 a. m...	10,883	.683	7.4	96.6	14.8	111.4	104.0	— 20.5	83.5
	Total, 6 hours	30,316	......	20.7	287.3	41.6	328.9	308.2	+ 21.5	329.7
	1 a. m. to 3 a. m...	10,105	.690	7.0	95.5	13.1	108.6	101.6	— 17.3	84.3
	3 a. m. to 5 a. m...	9,328	.690	6.4	97.8	12.8	110.6	104.2	— 22.3	81.9
	5 a. m. to 7 a. m...	10,105	.690	7.0	96.8	13.4	110.2	103.2	— 25.1	78.1
	Total, 6 hours	29,538	......	20.4	290.1	39.3	329.4	309.0	— 64.7	244.3
	Total, 1 day..	115,822	......	89.4	1,177.1	164.7	1,341.8	1,252.4	+2,224.0	3,476.4
	Total, 4 days.	467,170	......	358.6	4,650.2	676.9	5,327.1	4,968.5	+8,216.4	13,184.9
	Experiment No. 42.									
6–7.......	7 a. m. to 9 a. m...	10,105	.681	6.9	86.5	13.2	99.7	92.8	— 8.4	84.4
	9 a. m. to 11 a. m..	8,551	.681	5.8	66.8	10.2	77.0	71.2	— 7.7	63.5
	11 a. m. to 1 p. m..	9,328	.681	6.4	78.6	12.2	90.8	84.4	— 7.5	76.9
	Total, 6 hours	27,984	......	19.1	231.9	35.6	267.5	248.4	— 23.6	224.8
	1 p. m. to 3 p. m...	6,996	.672	4.7	75.3	10.2	85.5	80.8	— 22.2	58.6
	3 p. m. to 5 p. m...	11,660	.672	7.8	80.4	13.6	94.0	86.2	— 20.0	66.2
	5 p. m. to 7 p. m...	10,105	.672	6.8	80.6	12.4	93.0	86.2	— 17.1	69.1
	Total, 6 hours	28,761	......	19.3	236.3	36.2	272.5	253.2	— 59.3	193.9
	7 p. m. to 9 p. m...	10,105	.641	6.5	77.3	13.1	90.4	83.9	— 9.9	74.0
	9 p. m. to 11 p. m..	10,105	.641	6.5	77.4	12.9	90.3	83.8	— 10.1	73.7
	11 p. m. to 1 a. m..	10,105	.641	6.5	72.1	13.4	85.5	79.0	— 8.0	71.0
	Total, 6 hours	30,315	......	19.5	226.8	39.4	266.2	246.7	— 28.0	218.7
	1 a. m. to 3 a. m...	10,105	.624	6.3	71.1	12.3	83.4	77.1	— 11.1	66.0
	3 a. m. to 5 a. m...	9,328	.624	5.8	69.4	12.1	81.5	75.7	— 7.6	68.1
	5 a. m. to 7 a. m...	10,105	.624	6.3	72.2	12.3	84.5	78.2	— 8.0	70.2
	Total, 6 hours	29,538	......	18.4	212.7	36.7	249.4	231.0	— 26.7	204.3
	Total, 1 day..	116,598	......	76.3	907.7	147.9	1,055.6	979.3	— 137.6	841.7
	Experiment No. 43.									
29–30.......	7 a. m. to 9 a. m...	9,328	.771	7.2	78.7	18.8	97.5	90.3	+ 179.8	270.1
	9 a. m. to 11 a. m..	10,105	.771	7.8	96.9	18.1	115.0	107.2	+ 436.6	543.8
	11 a. m. to 1 p. m..	9,328	.771	7.2	93.3	17.5	110.8	103.6	+ 384.0	487.6
	Total, 6 hours	28,761	......	22.2	268.9	54.4	323.3	301.1	+1,000.4	1,301.5
	1 p. m. to 3 p. m...	9,328	.771	7.2	94.6	15.2	109.8	102.6	+ 331.6	434.2
	3 p. m. to 5 p. m...	9,328	.771	7.2	102.1	17.1	119.2	112.0	+ 547.9	659.9
	5 p. m. to 7 p. m...	10,105	.771	7.8	107.5	17.1	124.6	116.8	+ 394.1	510.9
	Total, 6 hours	28,761	......	22.2	304.2	49.4	353.6	331.4	+1,273.6	1,605.0

TABLE 120.—*Record of water in ventilating air current, etc.*—Continued.

Date.	Period.	(a) Ventilation (number of liters of air).	Water in incoming air. (b) Per liter.	(c) Total, a×b.	Water in outgoing air. (d) Amount condensed in freezers.	(e) Amount not condensed in freezers.	(f) Total, d+e.	(g) Total excess water in outgoing air, f−c.	(h) Correction for water remaining in chamber.	(i) Total water of respiration and perspiration, g+h.
1901.	*Experiment No. 43*—Continued.	*Liters.*	*Mgs.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*
Mar. 29–30	7 p. m. to 9 p. m.	10,105	0.731	7.4	93.1	16.7	109.8	102.4	+ 23.6	126.0
	9 p. m. to 11 p. m.	10,105	.731	7.4	87.3	14.8	102.1	94.7	+ 25.8	120.5
	11 p. m. to 1 a. m.	9,328	.731	6.8	87.7	14.9	102.6	95.8	− 10.5	85.3
	Total, 6 hours	29,538	......	21.6	268.1	46.4	314.5	292.9	+ 38.9	331.8
	1 a. m. to 3 a. m.	10,105	.605	6.1	92.0	14.3	106.3	100.2	− 5.9	94.3
	3 a. m. to 5 a. m.	10,105	.605	6.1	89.6	15.3	104.9	98.8	− 11.1	87.7
	5 a. m. to 7 a. m.	10,105	.605	6.1	85.7	14.4	100.1	94.0	− 11.5	82.5
	Total, 6 hours	30,315	......	18.3	267.3	44.0	311.3	293.0	− 28.5	264.5
	Total, 1 day	117,375	......	84.3	1,108.5	194.2	1,302.7	1,218.4	+2,284.4	3,502.8
30–31	7 a. m. to 9 a. m.	9,328	.794	7.4	84.5	15.1	99.6	92.2	+ 194.9	287.1
	9 a. m. to 11 a. m.	10,105	.794	8.0	106.7	16.2	122.9	114.9	+ 511.0	625.9
	11 a. m. to 1 p. m.	9,328	.794	7.4	99.0	15.7	114.7	107.3	+ 421.2	528.5
	Total, 6 hours	28,761	......	22.8	290.2	47.0	337.2	314.4	+1,127.1	1,441.5
	1 p. m. to 3 p. m.	9,328	.722	6.7	95.0	14.1	109.1	102.4	+ 235.5	337.9
	3 p. m. to 5 p. m.	9,328	.722	6.7	93.6	16.0	109.6	102.9	+ 393.2	496.1
	5 p. m. to 7 p. m.	10,105	.722	7.3	102.2	15.8	118.0	110.7	+ 205.3	316.0
	Total, 6 hours	28,761	......	20.7	290.8	45.9	336.7	316.0	+ 834.0	1,150.0
	7 p. m. to 9 p. m.	10,105	.782	7.9	98.1	15.1	113.2	105.3	+ 17.3	122.6
	9 p. m. to 11 p. m.	10,105	.782	7.9	92.6	14.3	106.9	99.0	+ 33.0	132.0
	11 p. m. to 1 a. m.	10,105	.782	7.9	93.0	14.3	107.3	99.4	− 13.2	86.2
	Total, 6 hours	30,315	......	23.7	283.7	43.7	327.4	303.7	+ 37.1	340.8
	1 a. m. to 3 a. m.	10,105	.632	6.4	92.4	14.1	106.5	100.1	− 15.3	84.8
	3 a. m. to 5 a. m.	10,105	.632	6.4	89.6	15.0	104.6	98.2	− 15.1	83.1
	5 a. m. to 7 a. m.	10,883	.632	6.9	97.3	15.4	112.7	105.8	− 9.6	96.2
	Total, 6 hours	31,093	......	19.7	279.3	44.5	323.8	304.1	− 40.0	264.1
	Total, 1 day	118,930	......	86.9	1,144.0	181.1	1,325.1	1,238.2	+1,958.2	3,196.4
31–Apr. 1	7 a. m. to 9 a. m.	9,328	.770	7.2	90.7	15.2	105.9	98.7	+ 216.7	315.4
	9 a. m. to 11 a. m.	9,328	.770	7.2	93.0	13.8	106.8	99.6	+ 390.3	489.9
	11 a. m. to 1 p. m.	9,328	.770	7.2	91.5	14.1	105.6	98.4	+ 297.1	395.5
	Total, 6 hours	27,984	......	21.6	275.2	43.1	318.3	296.7	+ 904.1	1,200.8
	1 p. m. to 3 p. m.	9,328	.789	7.4	96.8	12.4	109.2	101.8	+ 292.7	394.5
	3 p. m. to 5 p. m.	8,551	.789	6.7	90.9	13.1	104.0	97.3	+ 493.4	590.7
	5 p. m. to 7 p. m.	9,328	.789	7.4	100.2	13.7	113.9	106.5	+ 263.7	370.2
	Total, 6 hours	27,207	......	21.5	287.9	39.2	327.1	305.6	+1,049.8	1,355.4
	7 p. m. to 9 p. m.	10,105	.719	7.3	89.7	14.8	104.5	97.2	+ 28.3	125.5
	9 p. m. to 11 p. m.	9,328	.719	6.7	85.4	12.5	97.9	91.2	+ 25.1	116.3
	11 p. m. to 1 a. m.	10,105	.719	7.3	89.5	14.3	103.8	96.5	− 17.1	79.4
	Total, 6 hours	29,538	......	21.3	264.6	41.6	306.2	284.9	+ 36.3	321.2

TABLE 120.—*Record of water in ventilating air current, etc.*—Continued.

Date.	Period.	(a) Ventilation (number of liters of air).	Water in incoming air. (b) Per liter.	(c) Total, $a \times b$.	Water in outgoing air. (d) Amount condensed in freezers.	(e) Amount not condensed in freezers.	(f) Total, $d+e$.	(g) Total excess water in outgoing air, $f-c$.	(h) Correction for water remaining in chamber.	(i) Total water of respiration and perspiration, $g+h$.
1901.	*Experiment No. 43*—Continued.	*Liters.*	*Mgs.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*
Mar. 31–Apr. 1.	1 a. m. to 3 a. m ...	10,105	0.719	7.3	94.0	13.8	107.8	100.5	− 21.5	79.0
	3 a. m. to 5 a. m ...	10,105	.719	7.3	91.2	14.8	106.0	98.7	− 20.9	77.8
	5 a. m. to 7 a. m ...	10,105	.719	7.3	90.3	13.8	104.1	96.8	− 24.9	71.9
	Total, 6 hours	30,315	......	21.9	275.5	42.4	317.9	296.0	− 67.3	228.7
	Total, 1 day .	115,044	......	86.3	1,103.2	166.3	1,269.5	1,183.2	+1,922.9	3,106.1
Apr. 1–2.......	7 a. m. to 9 a. m ...	9,328	.875	8.2	86.2	14.2	100.4	92.2	+ 171.9	264.1
	9 a. m. to 11 a. m ..	7,774	.875	6.8	80.3	11.4	91.7	84.9	+ 445.5	530.4
	11 a. m. to 1 p. m ..	9,328	.875	8.2	90.7	14.7	105.4	97.2	+ 289.5	386.7
	Total, 6 hours	26,430	......	23.2	257.2	40.3	297.5	274.3	+ 906.9	1,181.2
	1 p. m. to 3 p. m ...	8,551	.798	6.8	81.6	12.0	93.6	86.8	+ 225.6	312.4
	3 p. m. to 5 p. m ...	9,328	.798	7.4	95.0	14.5	109.5	102.1	+ 366.5	468.6
	5 p. m. to 7 p. m ...	9,328	.798	7.4	95.0	14.1	109.1	101.7	+ 342.4	444.1
	Total, 6 hours	27,207	......	21.6	271.6	40.6	312.2	290.6	+ 934.5	1,225.1
	7 p. m. to 9 p. m ...	9,328	.755	7.0	85.3	13.6	98.9	91.9	+ 23.8	115.7
	9 p. m. to 11 p. m ..	10,105	.755	7.6	90.0	13.7	103.7	96.1	+ 21.1	117.2
	11 p. m. to 1 a. m ..	10,105	.755	7.6	93.6	15.2	108.8	101.2	− 8.2	93.0
	Total, 6 hours	29,538	......	22.2	268.9	42.5	311.4	289.2	+ 36.7	325.9
	1 a. m. to 3 a. m ...	10,105	.829	8.4	96.2	14.7	110.9	102.5	− 10.3	92.2
	3 a. m. to 5 a. m ...	10,105	.829	8.4	87.9	15.6	103.5	95.1	− 13.5	81.6
	5 a. m. to 7 a. m ...	9,328	.829	7.7	87.0	12.8	99.8	92.1	− 11.8	80.3
	Total, 6 hours	29,538	......	24.5	271.1	43.1	314.2	289.7	− 35.6	254.1
	Total, 1 day .	112,713	......	91.5	1,068.8	166.5	1,235.3	1,143.8	+1,842.5	2,986.3
	Total, 4 days.	464,062	......	349.0	4,424.5	708.1	5,132.6	4,783.6	+8,008.0	12,791.6
	Experiment No. 44.									
2–3.......	7 a. m. to 9 a. m ...	10,105	.880	8.9	84.2	15.6	99.8	90.9	+ 165.9	256.8
	9 a. m. to 11 a. m ..	9,328	.880	8.2	91.1	14.4	105.5	97.3	+ 367.6	464.9
	11 a. m. to 1 p. m ..	9,328	.880	8.2	91.0	15.5	106.5	98.3	+ 341.1	439.4
	Total, 6 hours	28,761	......	25.3	266.3	45.5	311.8	286.5	+ 874.6	1,161.1
	1 p. m. to 3 p. m ...	9,328	.895	8.3	92.0	13.4	105.4	97.1	+ 208.9	306.0
	3 p. m. to 5 p. m ...	8,551	.895	7.7	89.5	13.7	103.2	95.5	+ 432.7	528.2
	5 p. m. to 7 p. m ...	9,328	.895	8.3	101.0	15.5	116.5	108.2	+ 482.0	590.2
	Total, 6 hours	27,207	......	24.3	282.5	42.6	325.1	300.8	+1,123.6	1,424.4
	7 p. m. to 9 p. m ...	9,328	.886	8.3	92.8	14.7	107.5	99.2	+ 18.6	117.8
	9 p. m. to 11 p. m ..	9,328	.886	8.3	89.5	13.1	102.6	94.3	+ 35.1	129.4
	11 p. m. to 1 a. m ..	9,328	.886	8.3	91.6	13.6	105.2	96.9	− 7.7	89.2
	Total, 6 hours	27,984	......	24.9	273.9	41.4	315.3	290.4	+ 46.0	336.4

TABLE 120.—*Record of water in ventilating air current, etc.*—Continued.

Date.	Period.	(*a*) Ventilation (number of liters of air).	Water in incoming air. (*b*) Per liter.	(*c*) Total, *a*×*b*.	Water in outgoing air. (*d*) Amount condensed in freezers.	(*e*) Amount not condensed in freezers.	(*f*) Total, *d*+*c*.	(*g*) Total excess water in outgoing air, *f*−*c*.	(*h*) Correction for water remaining in chamber.	(*i*) Total water of respiration and perspiration, *g*+*h*.
1901.	*Experiment No. 44*—Continued.	*Liters.*	*Mgs.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*
Apr. 2–3	1 a. m. to 3 a. m	9,328	0.844	7.9	94.3	12.9	107.2	99.3	− 12.9	86.4
	3 a. m. to 5 a. m	10,105	.844	8.5	88.2	14.6	102.8	94.3	− 12.0	82.3
	5 a. m. to 7 a. m	9,328	.844	7.9	89.7	13.0	102.7	94.8	− 12.3	82.5
	Total, 6 hours	28,761	......	24.3	272.2	40.5	312.7	288.4	− 37.2	251.2
	Total, 1 day	112,713	......	98.8	1,094.9	170.0	1,264.9	1,166.1	+2,007.0	3,173.1
3–4	7 a. m. to 9 a. m	8,551	.941	8.1	80.5	12.7	93.2	85.1	+ 152.1	237.2
	9 a. m. to 11 a. m	8,551	.941	8.1	85.2	13.1	98.3	90.2	+ 366.1	456.3
	11 a. m. to 1 p. m	8,551	.941	8.1	83.0	14.4	97.4	89.3	+ 342.0	431.3
	Total, 6 hours	25,653	......	24.3	248.7	40.2	288.9	264.6	+ 860.2	1,124.8
	1 p. m. to 3 p. m	8,551	.963	8.2	86.3	12.3	98.6	90.4	+ 223.0	313.4
	3 p. m. to 5 p. m	8,551	.963	8.2	89.6	14.6	104.2	96.0	+ 464.5	560.5
	5 p. m. to 7 p. m	10,105	.963	9.7	106.4	16.3	122.7	113.0	+ 366.7	479.7
	Total, 6 hours	27,207	......	26.1	282.3	43.2	325.5	299.4	+1,054.2	1,353.6
	7 p. m. to 9 p. m	9,328	.954	8.9	90.7	13.8	104.5	95.6	+ 60.4	156.0
	9 p. m. to 11 p. m	10,105	.954	9.5	84.7	13.9	98.6	89.1	+ 11.9	101.0
	11 p. m. to 1 a. m	10,105	.954	9.5	85.8	15.6	101.4	91.9	− 18.8	73.1
	Total, 6 hours	29,538	......	27.9	261.2	43.3	304.5	276.6	+ 53.5	330.1
	1 a. m. to 3 a. m	9,328	.768	7.2	85.8	12.7	98.5	91.3	− 18.2	73.1
	3 a. m. to 5 a. m	10,105	.768	7.8	88.7	15.1	103.8	96.0	− 19.9	76.1
	5 a. m. to 7 a. m	10,882	.768	8.4	92.3	14.5	106.8	98.4	− 21.3	77.1
	Total, 6 hours	30,315	......	23.4	266.8	42.3	309.1	285.7	− 59.4	226.3
	Total, 1 day	112,713	......	101.7	1,059.0	169.0	1,228.0	1,126.3	+1,908.5	3,034.8
4–5	7 a. m. to 9 a. m	8,551	.927	8.0	79.1	12.8	91.9	83.9	+ 156.3	240.2
	9 a. m. to 11 a. m	9,328	.927	8.7	90.4	13.9	104.3	95.6	+ 387.9	483.5
	11 a. m. to 1 p. m	10,105	.927	9.4	101.8	16.4	118.2	108.8	+ 338.3	447.1
	Total, 6 hours	27,984	......	26.1	271.3	43.1	314.4	288.3	+ 882.5	1,170.8
	1 p. m. to 3 p. m	9,328	.978	9.1	94.0	13.4	107.4	98.3	+ 252.4	350.7
	3 p. m. to 5 p. m	9,328	.978	9.1	97.0	16.0	113.0	103.9	+ 508.6	612.5
	5 p. m. to 7 p. m	10,105	.978	9.9	101.0	16.4	117.4	107.5	+ 334.8	442.3
	Total, 6 hours	28,761	......	28.1	292.0	45.8	337.8	309.7	+1,095.8	1,405.5
	7 p. m. to 9 p. m	9,328	.797	7.4	91.3	13.5	104.8	97.4	+ 35.5	132.9
	9 p. m. to 11 p. m	10,105	.797	8.1	87.6	13.6	101.2	93.1	+ 13.0	106.1
	11 p. m. to 1 a. m	10,105	.797	8.1	86.2	14.9	101.1	93.0	− 21.7	71.3
	Total, 6 hours	29,538	......	23.6	265.1	42.0	307.1	283.5	+ 26.8	310.3
	1 a. m. to 3 a. m	10,105	.881	8.9	87.3	13.4	100.7	91.8	− 20.4	71.4
	3 a. m. to 5 a. m	10,105	.881	8.9	81.9	14.4	96.3	87.4	− 19.5	67.9
	5 a. m. to 7 a. m	10,105	.881	8.9	87.3	13.2	100.5	91.6	− 19.8	71.8
	Total, 6 hours	30,315	......	26.7	256.5	41.0	297.5	270.8	− 59.7	211.1
	Total, 1 day	116,598	......	104.5	1,084.9	171.9	1,256.8	1,152.3	+1,945.4	3,097.7

TABLE 120.—*Record of water in ventilating air current, etc.*—Continued.

Date.	Period.	(a) Ventilation (number of liters of air).	Water in incoming air. (b) Per liter.	(c) Total, a×b.	Water in outgoing air. (d) Amount condensed in freezers.	(e) Amount not condensed in freezers.	(f) Total, d+e.	(g) Total excess water in outgoing air, f−c.	(h) Correction for water remaining in chamber.	(i) Total water of respiration and perspiration, g+h.
	Experiment No. 44—Continued.									
1901.		*Liters.*	*Mgs.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*
Apr. 5–6	7 a. m. to 9 a. m	9,328	0.966	9.0	83.4	14.4	97.8	88.8	+ 194.8	283.6
	9 a. m. to 11 a. m	9,328	.966	9.0	97.8	14.4	112.2	103.2	+ 469.4	572.6
	11 a. m. to 1 p. m	9,328	.966	9.0	95.9	15.7	111.6	102.6	+ 429.1	531.7
	Total, 6 hours	27,984	......	27.0	277.1	44.5	321.6	294.6	+1,093.3	1,387.9
	1 p. m. to 3 p. m	10,105	.952	9.6	108.7	13.7	122.4	112.8	+ 272.0	384.8
	3 p. m. to 5 p. m	9,328	.952	8.9	98.5	15.1	113.6	104.7	+ 495.1	599.8
	5 p. m. to 7 p. m	9,328	.952	8.9	105.2	14.6	119.8	110.9	+ 458.5	569.4
	Total, 6 hours	28,761	......	27.4	312.4	43.4	355.8	328.4	+1,225.6	1,554.0
	7 p. m. to 9 p. m	10,105	.938	9.5	94.8	14.6	109.4	99.9	+ 35.6	135.5
	9 p. m. to 11 p. m	9,328	.938	8.8	90.5	12.6	103.1	94.3	+ 35.6	129.9
	11 p. m. to 1 a. m	10,105	.938	9.5	93.4	13.9	107.3	97.8	− 6.1	91.7
	Total, 6 hours	29,538	......	27.8	278.7	41.1	319.8	292.0	+ 65.1	357.1
	1 a. m. to 3 a. m	10,105	.747	7.6	97.6	14.2	111.8	104.2	− 11.6	92.6
	3 a. m. to 5 a. m	10,105	.747	7.6	93.6	15.1	108.7	101.1	− 8.9	92.2
	5 a. m. to 7 a. m	10,883	.747	8.1	96.9	14.6	111.5	103.4	− 11.9	91.5
	Total, 6 hours	31,093	......	23.3	288.1	43.9	332.0	308.7	− 32.4	276.3
	Total, 1 day	117,376	......	105.5	1,156.3	172.9	1,329.2	1,223.7	+2,351.6	3,575.3
	Total, 4 days	459,400	......	410.5	4,395.1	683.8	5,078.9	4,668.4	+8,212.5	12,880.9
	Experiment No. 45.									
6–7	7 a. m. to 9 a. m	9,328	.969	9.0	88.4	13.5	101.9	92.9	+ 160.7	253.6
	9 a. m. to 11 a. m	9,328	.969	9.0	97.8	13.7	111.5	102.5	+ 437.8	540.3
	11 a. m. to 1 p. m	10,105	.969	9.8	104.8	16.0	120.8	111.0	+ 413.9	524.9
	Total, 6 hours	28,761	......	27.8	291.0	43.2	334.2	306.4	+1,012.4	1,318.8
	1 p. m. to 3 p. m	9,328	1.006	9.4	97.7	12.3	110.0	100.6	+ 230.7	331.3
	3 p. m. to 5 p. m	9,328	1.006	9.4	101.8	14.3	116.1	106.7	+ 435.4	542.1
	5 p. m. to 7 p. m	10,105	1.006	10.2	101.0	14.6	115.6	105.4	+ 289.7	395.1
	Total, 6 hours	28,761	......	29.0	300.5	41.2	341.7	312.7	+ 955.8	1,268.5
	7 p. m. to 9 p. m	9,328	.915	8.8	94.4	12.2	106.6	97.8	+ 31.1	128.9
	9 p. m. to 11 p. m	10,105	.915	9.5	94.4	12.7	107.1	97.6	+ 19.5	117.1
	11 p. m. to 1 a. m	9,328	.915	8.8	89.6	12.9	102.5	93.7	− 15.7	78.0
	Total, 6 hours	28,761	......	27.1	278.4	37.8	316.2	289.1	+ 34.9	324.0
	1 a. m. to 3 a. m	10,105	.763	7.7	91.9	13.4	105.3	97.6	− 6.6	91.0
	3 a. m. to 5 a. m	10,105	.763	7.7	88.3	14.4	102.7	95.0	− 15.8	79.2
	5 a. m. to 7 a. m	10,105	.763	7.7	89.1	12.9	102.0	94.3	− 15.1	79.2
	Total, 6 hours	30,315	......	23.1	269.3	40.7	310.0	286.9	− 37.5	249.4
	Total, 1 day	116,598	......	107.0	1,139.2	162.9	1,302.1	1,195.1	+1,965.6	3,160.7

TABLE 120.—*Record of water in ventilating air current, etc.*—Continued.

Date.	Period.	(a) Ventilation (number of liters of air).	Water in incoming air. (b) Per liter.	Water in incoming air. (c) Total, $a \times b$.	Water in outgoing air. (d) Amount condensed in freezers.	Water in outgoing air. (e) Amount not condensed in freezers.	Water in outgoing air. (f) Total, $d+e$.	(g) Total excess water in outgoing air, $f-c$.	(h) Correction for water remaining in chamber.	(i) Total water of respiration and perspiration, $g+h$.
1901.	*Experiment No. 46.*	*Liters.*	*Mgs.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*
May 3–4.......	7 a. m. to 9 a. m...	9,328	0.895	8.3	100.0	22.3	122.3	114.0	+ 274.9	388.9
	9 a. m. to 11 a. m..	9,328	.895	8.3	113.6	20.2	133.8	125.5	+ 568.1	693.6
	11 a. m. to 1 p. m..	8,551	.895	7.6	108.8	18.7	127.5	119.9	+ 470.2	590.1
	Total, 6 hours	27,207	......	24.2	322.4	61.2	383.6	359.4	+1,313.2	1,672.6
	1 p. m. to 3 p. m...	9,328	.850	7.9	116.7	16.8	133.5	125.6	+ 296.5	422.1
	3 p. m. to 5 p. m...	8,551	.850	7.3	108.3	16.3	124.6	117.3	+ 532.7	650.0
	5 p. m. to 7 p. m...	9,328	.850	7.9	120.9	17.2	138.1	130.2	+ 495.3	625.5
	Total, 6 hours	27,207	......	23.1	345.9	50.3	396.2	373.1	+1,324.5	1,697.6
	7 p. m. to 9 p. m...	9,328	.850	7.9	113.6	17.1	130.7	122.8	+ 41.0	163.8
	9 p. m. to 11 p. m..	9,328	.850	7.9	109.1	15.2	124.3	116.4	+ 31.6	148.0
	11 p. m. to 1 a. m..	10,105	.850	8.6	117.7	17.0	134.7	126.1	− 4.6	121.5
	Total, 6 hours	28,761	......	24.4	340.4	49.3	389.7	365.3	+ 68.0	433.3
	1 a. m. to 3 a. m...	9,328	.711	6.6	109.2	14.4	123.6	117.0	− 6.5	110.5
	3 a. m. to 5 a. m...	9,328	.711	6.6	111.1	15.0	126.1	119.5	− 13.0	106.5
	5 a. m. to 7 a. m...	9,328	.711	6.6	109.2	13.5	122.7	116.1	− 10.1	106.0
	Total, 6 hours	27,984	......	19.8	329.5	42.9	372.4	352.6	− 29.6	323.0
	Total, 1 day..	111,159	......	91.5	1,338.2	203.7	1,541.9	1,450.4	+2,676.1	4,126.5
4–5.......	7 a. m. to 9 a. m...	9,328	.844	7.9	105.3	13.9	119.2	111.3	+ 239.8	351.1
	9 a. m. to 11 a. m..	8,551	.844	7.2	108.8	13.3	122.1	114.9	+ 485.8	600.7
	11 a. m. to 1 p. m..	9,328	.844	7.9	118.0	16.6	134.6	126.7	+ 456.7	583.4
	Total, 6 hours	27,207	......	23.0	332.1	43.8	375.9	352.9	+1,182.3	1,535.2
	1 p. m. to 3 p. m...	8,551	.964	8.2	107.5	13.2	120.7	112.5	+ 305.8	418.3
	3 p. m. to 5 p. m...	9,328	.964	9.0	117.5	16.4	133.9	124.9	+ 491.6	616.5
	5 p. m. to 7 p. m...	8,551	.964	8.2	115.1	15.0	130.1	121.9	+ 382.3	504.2
	Total, 6 hours	26,430	......	25.4	340.1	44.6	384.7	359.3	+1,179.7	1,539.0
	7 p. m. to 9 p. m...	9,328	.856	8.0	114.6	15.4	130.0	122.0	+ 29.8	151.8
	9 p. m. to 11 p. m..	9,328	.856	8.0	111.7	14.3	126.0	118.0	+ 20.0	138.0
	11 p. m. to 1 a. m..	9,328	.856	8.0	115.6	14.5	130.1	122.1	− 4.6	117.5
	Total, 6 hours	27,984	......	24.0	341.9	44.2	386.1	362.1	+ 45.2	407.3
	1 a. m. to 3 a. m...	9,328	.663	6.2	119.2	13.5	132.7	126.5	− 8.8	117.7
	3 a. m. to 5 a. m...	9,328	.663	6.2	118.0	14.1	132.1	125.9	− 11.9	114.0
	5 a. m. to 7 a. m...	9,328	.663	6.2	109.9	12.5	122.4	116.2	− 12.6	103.6
	Total, 6 hours	27,984	......	18.6	347.1	40.1	387.2	368.6	− 33.3	335.3
	Total, 1 day..	109,605	......	91.0	1,361.2	172.7	1,533.9	1,442.9	+2,373.9	3,816.8

TABLE 120.—*Record of water in ventilating air current, etc.*—Continued.

Date.	Period.	(*a*) Ventilation (number of liters of air).	Water in incoming air. (*b*) Per liter.	Water in incoming air. (*c*) Total, $a \times b$.	Water in outgoing air. (*d*) Amount condensed in freezers.	Water in outgoing air. (*e*) Amount not condensed in freezers.	Water in outgoing air. (*f*) Total, $d+e$.	(*g*) Total excess water in outgoing air, $f-c$.	(*h*) Correction for water remaining in chamber.	(*i*) Total water of respiration and perspiration, $g+h$.
	Experiment No. 46—Continued.									
1901.		*Liters.*	*Mgs.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*
May 5–6.......	7 a. m. to 9 a. m ...	9,328	0.800	7.5	103.2	14.1	117.3	109.8	+ 249.1	358.9
	9 a. m. to 11 a. m ..	9,328	.800	7.5	120.6	14.3	134.9	127.4	+ 489.9	617.3
	11 a. m. to 1 p. m ..	8,551	.800	6.8	109.4	14.4	123.8	117.0	+ 447.4	564.4
	Total, 6 hours	27,207	......	21.8	333.2	42.8	376.0	354.2	+1,186.4	1,540.6
	1 p. m. to 3 p. m ...	9,328	.905	8.4	116.5	14.0	130.5	122.1	+ 266.8	388.9
	3 p. m. to 5 p. m ...	8,551	.905	7.7	112.3	14.6	126.9	119.2	+ 516.5	635.7
	5 p. m. to 7 p. m ...	9,328	.905	8.4	124.3	15.4	139.7	131.3	+ 365.8	497.1
	Total, 6 hours	27,207	......	24.5	353.1	44.0	397.1	372.6	+1,149.1	1,521.7
	7 p. m. to 9 p. m ...	9,328	.788	7.4	109.7	14.9	124.6	117.2	+ 30.3	147.5
	9 p. m. to 11 p. m ..	9,328	.788	7.4	102.5	13.0	115.5	108.1	+ 19.2	127.3
	11 p. m. to 1 a. m ..	9,328	.788	7.4	110.3	13.9	124.2	116.8	− 2.3	114.5
	Total, 6 hours	27,984	......	22.2	322.5	41.8	364.3	342.1	+ 47.2	389.3
	1 a. m. to 3 a. m ...	9,328	.765	7.1	116.8	13.3	130.1	123.0	− 10.4	112.6
	3 a. m. to 5 a. m ...	9,328	.765	7.1	105.8	14.8	120.6	113.5	− 14.7	98.8
	5 a. m. to 7 a. m ...	9,328	.765	7.1	103.0	12.3	115.3	108.2	− 15.6	92.6
	Total, 6 hours	27,984	......	21.3	325.6	40.4	366.0	344.7	− 40.7	304.0
	Total, 1 day .	110,382	......	89.8	1,334.4	169.0	1,503.4	1,413.6	+2,342.0	3,755.6
6–7.......	7 a. m. to 9 a. m ...	9,328	.903	8.4	103.7	13.5	117.2	108.8	+ 193.0	301.8
	9 a. m. to 11 a. m ..	8,551	.903	7.7	110.0	13.2	123.2	115.5	+ 460.1	575.6
	11 a. m. to 1 p. m ..	9,328	.903	8.4	118.2	16.5	134.7	126.3	+ 416.1	542.4
	Total, 6 hours.	27,207	......	24.5	331.9	43.2	375.1	350.6	+1,069.2	1,419.8
	1 p. m. to 3 p. m ...	9,328	.886	8.3	116.7	15.0	131.7	123.4	+ 250.8	374.2
	3 p. m. to 5 p. m ...	8,551	.886	7.6	113.5	15.0	128.5	120.9	+ 491.8	612.7
	5 p. m. to 7 p. m ...	8,551	.886	7.6	115.7	14.3	130.0	122.4	+ 350.7	473.1
	Total, 6 hours	26,430	......	23.5	345.9	44.3	390.2	366.7	+1,093.3	1,460.0
	7 p. m. to 9 p. m ...	9,328	.791	7.4	108.7	14.6	123.3	115.9	+ 35.6	151.5
	9 p. m. to 11 p. m ..	9,328	.791	7.4	103.6	13.1	116.7	109.3	+ 13.4	122.7
	11 p. m. to 1 a. m ..	9,328	.791	7.4	113.3	14.7	128.0	120.6	− 4.3	116.3
	Total, 6 hours	27,984	......	22.2	325.6	42.4	368.0	345.8	+ 44.7	390.5
	1 a. m. to 3 a. m ...	9,328	.676	6.3	113.8	13.0	126.8	120.5	− 12.9	107.6
	3 a. m. to 5 a. m ...	9,328	.676	6.3	105.8	14.1	119.9	113.6	− 10.3	103.3
	5 a. m. to 7 a. m ...	9,328	.676	6.3	104.0	12.6	116.6	110.3	− 10.6	99.7
	Total, 6 hours	27,984	......	18.9	323.6	39.7	363.3	344.4	− 33.8	310.6
	Total, 1 day .	109,605	......	89.1	1,327.0	169.6	1,496.6	1,407.5	+2,173.4	3,580.9
	Total, 4 days.	440,751	......	361.4	3,360.8	715.0	6,075.8	5,714.4	+9,565.4	15,279.8

TABLE 120.—*Record of water in ventilating air current, etc.*—Continued.

Date.	Period.	(a) Ventilation (number of liters of air).	Water in incoming air. (b) Per liter.	(c) Total, $a \times b$.	Water in outgoing air. (d) Amount condensed in freezers.	(e) Amount not condensed in freezers.	(f) Total, $d+e$.	(g) Total excess water in outgoing air, $f-c$.	(h) Correction for water remaining in chamber.	(i) Total water of respiration and perspiration, $g+h$.
1901.	*Experiment No. 47.*	*Liters.*	*Mgs.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*
May 7–8	7 a. m. to 9 a. m.	9,328	0.808	7.5	99.2	14.3	113.5	106.0	+ 207.5	313.5
	9 a. m. to 11 a. m.	9,328	.808	7.5	121.1	14.6	135.7	128.2	+ 519.0	647.2
	11 a. m. to 1 p. m.	8,551	.808	6.9	113.5	15.0	128.5	121.6	+ 482.3	603.9
	Total, 6 hours	27,207	......	21.9	333.8	43.9	377.7	355.8	+1,208.8	1,564.6
	1 p. m. to 3 p. m.	9,328	.906	8.5	114.5	14.9	129.4	120.9	+ 279.3	400.2
	3 p. m. to 5 p. m.	9,328	.906	8.5	121.5	17.3	138.8	130.3	+ 500.8	631.1
	5 p. m. to 7 p. m.	8,551	.906	7.7	112.2	15.0	127.2	119.5	+ 392.1	511.6
	Total, 6 hours	27,207	......	24.7	348.2	47.2	395.4	370.7	+1,172.2	1,542.9
	7 p. m. to 9 p. m.	9,328	1.050	9.8	103.1	15.3	118.4	108.6	+ 23.1	131.7
	9 p. m. to 11 p. m.	9,328	1.050	9.8	101.6	13.6	115.2	105.4	+ 14.5	119.9
	11 p. m. to 1 a. m.	8,551	1.050	9.0	109.6	13.0	122.6	113.6	+ 1.1	114.7
	Total, 6 hours	27,207	......	28.6	314.3	41.9	356.2	327.6	+ 38.7	366.3
	1 a. m. to 3 a. m.	9,328	.730	6.8	112.9	13.6	126.5	119.7	− 9.1	110.6
	3 a. m. to 5 a. m.	9,328	.730	6.8	106.7	14.3	121.0	114.2	− 9.9	104.3
	5 a. m. to 7 a. m.	9,328	.730	6.8	98.9	13.1	112.0	105.2	− 10.6	94.6
	Total, 6 hours	27,984	......	20.4	318.5	41.0	359.5	339.1	− 29.6	309.5
	Total, 1 day	109,605	......	95.6	1,314.8	174.0	1,488.8	1,393.2	+2,390.1	3,783.3
8–9	7 a. m. to 9 a. m.	8,551	.977	8.4	98.8	13.3	112.1	103.7	+ 204.8	308.5
	9 a. m. to 11 a. m.	9,328	.977	9.1	123.0	15.7	138.7	129.6	+ 528.1	657.7
	11 a. m. to 1 p. m.	8,551	.977	8.4	112.2	16.1	128.3	119.9	+ 470.8	590.7
	Total, 6 hours	26,430	......	25.9	334.0	45.1	379.1	353.2	+1,203.7	1,556.9
	1 p. m. to 3 p. m.	9,328	.931	8.7	116.7	15.9	132.6	123.9	+ 269.1	393.0
	3 p. m. to 5 p. m.	8,551	.931	8.0	111.1	16.3	127.4	119.4	+ 471.1	590.5
	5 p. m. to 7 p. m.	9,328	.931	8.7	118.0	16.9	134.9	126.2	+ 390.1	516.3
	Total, 6 hours	27,207	......	25.4	345.8	49.1	394.9	369.5	+1,130.3	1,499.8
	7 p. m. to 9 p. m.	8,551	.853	7.3	109.0	14.4	123.4	116.1	+ 29.7	145.8
	9 p. m. to 11 p. m.	9,328	.853	7.9	110.0	15.0	125.0	117.1	+ 26.4	143.5
	11 p. m. to 1 a. m.	9,328	.853	7.9	114.8	16.3	131.1	123.2	− 12.6	110.6
	Total, 6 hours	27,207	......	23.1	333.8	45.7	379.5	356.4	+ 43.5	399.9
	1 a. m. to 3 a. m.	9,328	.784	7.3	107.6	14.5	122.1	114.8	− 19.3	95.5
	3 a. m. to 5 a. m.	9,328	.784	7.3	106.5	16.2	122.7	115.4	− 20.9	94.5
	5 a. m. to 7 a. m.	10,105	.784	7.9	86.9	15.5	102.4	94.5	− 21.4	73.1
	Total, 6 hours	28,761	......	22.5	301.0	46.2	347.2	324.7	− 61.6	263.1
	Total, 1 day	109,605	......	96.9	1,314.6	186.1	1,500.7	1,403.8	+2,315.9	3,719.7
9–10	7 a. m. to 9 a. m.	8,551	.900	7.5	99.1	14.7	113.8	106.3	+ 219.9	326.2
	9 a. m. to 11 a. m.	9,328	.900	8.4	113.5	16.9	130.4	122.0	+ 552.8	674.8
	11 a. m. to 1 p. m.	9,328	.900	8.4	123.7	18.8	142.5	134.1	+ 465.4	599.5
	Total, 6 hours	27,207	......	24.3	336.3	50.4	386.7	362.4	+1,238.1	1,600.5

TABLE 120.—*Record of water in ventilating air current, etc.*—Continued.

Date.	Period	(a) Ventilation (number of liters of air).	Water in incoming air. (b) Per liter.	Water in incoming air. (c) Total, $a \times b$.	Water in outgoing air. (d) Amount condensed in freezers.	Water in outgoing air. (e) Amount not condensed in freezers.	Water in outgoing air. (f) Total, $d+e$.	(g) Total excess water in outgoing air, $f-c$.	(h) Correction for water remaining in chamber.	(i) Total water of respiration and perspiration, $g+h$.
	Experiment No. 47—Continued.									
1901.		*Liters.*	*Mgs.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*
May 9–10......	1 p. m. to 3 p. m...	8,551	0.920	7.9	116.7	15.0	131.7	123.8	+ 261.7	385.5
	3 p. m. to 5 p. m...	9,328	.920	8.6	120.2	18.9	139.1	130.5	+ 451.8	582.3
	5 p. m. to 7 p. m...	9,328	.920	8.6	118.6	17.6	136.2	127.6	+ 367.0	494.6
	Total, 6 hours	27,207	......	25.1	355.5	51.5	407.0	381.9	+1,080.5	1,462.4
	7 p. m. to 9 p. m...	8,551	1.038	8.9	109.2	17.0	126.2	117.3	+ 36.2	153.5
	9 p. m. to 11 p. m..	9,328	1.038	9.7	110.0	18.9	128.9	119.2	+ 31.3	150.5
	11 p. m. to 1 a. m..	9,328	1.038	9.7	113.3	16.5	129.8	120.1	− 5.7	114.4
	Total, 6 hours	27,207	......	28.3	332.5	52.4	384.9	356.6	+ 61.8	418.4
	1 a. m. to 3 a. m...	9,328	.934	8.7	114.9	16.5	131.4	122.7	− 24.3	98.4
	3 a. m. to 5 a. m...	10,105	.934	9.4	108.4	19.3	127.7	118.3	− 15.9	102.4
	5 a. m. to 7 a. m...	9,328	.934	8.7	98.8	15.5	114.3	105.6	− 16.3	89.3
	Total, 6 hours	28,761	......	26.8	322.1	51.3	373.4	346.6	− 56.5	290.1
	Total, 1 day..	110,382	......	104.5	1,346.4	205.6	1,552.0	1,447.5	+2,323.9	3,771.4
10–11......	7 a. m. to 9 a. m...	9,328	.985	9.2	103.8	17.6	121.4	112.2	+ 239.9	352.1
	9 a. m. to 11 a. m..	9,328	.985	9.2	121.1	18.5	139.6	130.4	+ 548.7	679.1
	11 a. m. to 1 p. m..	8,551	.985	8.4	110.0	18.9	128.9	120.5	+ 479.2	599.7
	Total, 6 hours	27,207	......	26.8	334.9	55.0	389.9	363.1	+1,267.8	1,630.9
	1 p. m to 3 p. m...	9,328	1.125	10.5	119.0	18.0	137.0	126.5	+ 270.5	397.0
	3 p. m. to 5 p. m...	8,551	1.125	9.6	114.2	19.3	133.5	123.9	+ 556.4	680.3
	5 p. m. to 7 p. m...	9,328	1.125	10.5	125.5	20.2	145.7	135.2	+ 447.0	582.2
	Total, 6 hours	27,207	......	30.6	358.7	57.5	416.2	385.6	+1,273.9	1,659.5
	7 p. m to 9 p. m...	9,328	1.000	9.3	109.6	19.1	128.7	119.4	+ 28.1	147.5
	9 p. m. to 11 p. m..	9,328	1.000	9.3	110.5	17.9	128.4	119.1	+ 34.1	153.2
	11 p. m. to 1 a. m..	9,328	1.000	9.3	115.7	18.5	134.2	124.9	− 9.9	115.0
	Total, 6 hours	27,984	......	27.9	335.8	55.5	391.3	363.4	+ 52.3	415.7
	1 a. m. to 3 a. m...	9,328	.837	7.8	118.4	17.0	135.4	127.6	− 14.0	113.6
	3 a. m. to 5 a. m...	9,328	.837	7.8	109.7	18.5	128.2	120.4	− 13.3	107.1
	5 a. m. to 7 a. m...	10,105	.837	8.5	105.4	16.4	121.8	113.3	− 16.1	97.2
	Total, 6 hours	28,761	......	24.1	333.5	51.9	385.4	361.3	− 43.4	317.9
	Total, 1 day..	111,159	......	109.4	1,362.9	219.9	1,582.8	1,473.4	+2,550.6	4,024.0
	Total, 4 days.	440,751	......	406.4	5,338.7	785.6	6,124.3	5,717.9	+9,580.5	15,298.4
	Experiment No. 48.									
11–12......	7 a. m. to 9 a. m...	8,551	1.033	8.8	98.7	15.4	114.1	105.3	+ 203.2	308.5
	9 a. m. to 11 a. m..	8,551	1.033	8.8	113.5	16.3	129.8	121.0	+ 491.8	612.8
	11 a. m. to 1 p. m..	9,328	1.033	9.6	123.3	20.6	143.9	134.3	+ 435.4	569.7
	Total, 6 hours	26,430	......	27.2	335.5	52.3	387.8	360.6	+1,130.4	1,491.0

TABLE 120.—*Record of water in ventilating air current, etc.*—Continued.

Date.	Period.	(a) Ventilation (number of liters of air).	Water in incoming air. (b) Per liter.	(c) Total, $a \times b$.	Water in outgoing air. (d) Amount condensed in freezers.	(e) Amount not condensed in freezers.	(f) Total, $d+e$.	(g) Total excess water in outgoing air, $f-c$.	(h) Correction for water remaining in chamber.	(i) Total water of respiration and perspiration, $g+h$.
1901.	*Experiment No. 48*—Continued.	*Liters.*	*Mgs.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*
May 11–12.....	1 p. m. to 3 p. m...	8,551	1.045	8.9	105.8	16.4	122.2	113.3	+ 261.9	375.2
	3 p. m. to 5 p. m...	8,551	1.045	8.9	115.2	19.5	134.7	125.8	+ 508.0	633.8
	5 p. m. to 7 p. m...	9,328	1.045	9.8	123.3	19.5	142.8	133.0	+ 340.5	473.5
	Total, 6 hours	26,430	......	27.6	344.3	55.4	399.7	372.1	+1,110.4	1,482.5
	7 p. m. to 9 p. m...	9,328	.984	9.2	114.9	19.3	134.2	125.0	+ 36.9	161.9
	9 p. m. to 11 p. m..	9,328	.984	9.2	112.7	17.1	129.8	120.6	+ 54.2	174.8
	11 p. m. to 1 a. m..	9,328	.984	9.2	118.4	18.2	136.6	127.4	+ .9	128.3
	Total, 6 hours	27,984	......	27.6	346.0	54.6	400.6	373.0	+ 92.0	465.0
	1 a. m. to 3 a. m...	9,328	.781	7.3	123.8	16.8	140.6	133.3	− 5.1	128.2
	3 a. m. to 5 a. m...	10,105	.781	7.9	121.9	19.3	141.2	133.3	− 6.4	126.9
	5 a. m. to 7 a. m...	9,328	.781	7.3	108.0	16.1	124.1	116.8	− 9.9	106.9
	Total, 6 hours	28,761	......	22.5	353.7	52.2	405.9	383.4	− 21.4	362.0
	Total, 1 day..	109,605	......	104.9	1,379.5	214.5	1,594.0	1,489.1	+2,311.4	3,800.5
1902.	*Experiment No. 49.*									
Mar. 27–28.....	7 a. m. to 9 a. m...	9,328	.706	6.6	84.4	15.3	99.7	93.1	+ 221.0	314.1
	9 a. m. to 11 a. m..	9,328	.706	6.6	91.2	16.0	107.2	100.6	+ 368.7	469.3
	11 a. m. to 1 p. m..	9,328	.706	6.6	87.3	17.7	105.0	98.4	+ 326.3	424.7
	Total, 6 hours	27,984	......	19.8	262.9	49.0	311.9	292.1	+ 916.0	1,208.1
	1 p. m. to 3 p. m...	9,328	.621	5.8	90.8	13.7	104.5	98.7	+ 285.1	383.9
	3 p. m. to 5 p. m...	9,328	.621	5.8	98.5	14.6	113.1	107.3	+ 514.1	621.4
	5 p. m. to 7 p. m...	9,328	.621	5.8	109.1	13.7	122.8	117.0	+ 467.1	584.1
	Total, 6 hours	27,984	......	17.4	298.4	42.0	340.4	323.0	+1,266.3	1,589.4
	7 p. m. to 9 p. m...	10,883	.611	6.6	109.6	17.2	126.8	120.2	+ 55.5	175.7
	9 p. m. to 11 p. m..	10,105	.611	6.2	103.0	13.1	116.1	109.9	+ 19.2	129.1
	11 p. m. to 1 a. m..	9,328	.611	5.7	95.2	13.0	108.2	102.5	+ 6.3	108.8
	Total, 6 hours	30,316	......	18.5	307.8	43.3	351.1	332.6	+ 81.0	413.6
	1 a. m. to 3 a. m...	9,328	.554	5.2	98.2	11.0	109.2	104.0	+ 1.7	105.7
	3 a. m. to 5 a. m...	9,338	.554	5.2	89.8	12.2	102.0	96.9	+ 1.7	98.6
	5 a. m. to 7 a. m...	9,328	.554	5.2	90.8	10.5	101.3	96.1	+ 2.5	98.6
	Total, 6 hours	27,984	......	15.6	278.8	33.7	312.5	297.0	+ 5.9	302.9
	Total, 1 day..	114,268	......	71.3	1,147.9	168.0	1,315.9	1,244.7	+2,269.2	3,514.0
28–29.....	7 a. m. to 9 a. m...	9,328	.771	7.2	80.5	13.5	94.0	86.9	+ 130.5	217.3
	9 a. m. to 11 a. m..	9,328	.771	7.2	98.4	14.1	112.5	105.3	+ 407.6	512.9
	11 a. m. to 1 p. m..	9,328	.771	7.2	90.8	16.9	107.7	100.5	+ 324.9	425.4
	Total, 6 hours	27,984	......	21.6	269.7	44.5	314.2	292.7	+ 863.0	1,155.6
	1 p. m. to 3 p. m...	9,328	.751	7.0	91.2	12.9	104.1	97.1	+ 223.6	320.7
	3 p. m. to 5 p. m...	9,328	.751	7.0	91.1	15.6	106.7	99.7	+ 446.2	545.9
	5 p. m. to 7 p. m...	9,328	.751	7.0	98.4	13.6	112.0	105.0	+ 285.1	390.1
	Total, 6 hours	27,984	......	21.0	280.7	42.1	322.8	301.8	+ 954.9	1,256.7

TABLE 120.—*Record of water in ventilating air current, etc.*—Continued.

Date.	Period.	(a) Ventilation (number of liters of air).	Water in incoming air. (b) Per liter.	(c) Total, a×b.	Water in outgoing air. (d) Amount condensed in freezers.	(e) Amount not condensed in freezers.	(f) Total, d+e.	(g) Total excess water in outgoing air, f−c.	(h) Correction for water remaining in chamber.	(i) Total water of respiration and perspiration, g+h.
	Experiment No. 49—Continued.									
1902.		*Liters.*	*Mgs.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*
Mar. 28–29.....	7 p. m. to 9 p. m...	10,105	0.640	6.5	98.9	16.8	115.7	109.2	+ 31.6	140.8
	9 p. m. to 11 p. m..	10,105	.640	6.5	97.1	12.6	109.7	103.2	+ 21.0	124.2
	11 p. m. to 1 a. m..	9,328	.640	6.0	88.7	12.0	100.7	94.7	+ 4.0	98.7
	Total, 6 hours	29,538	......	19.0	284.7	41.4	326.1	307.1	+ 56.6	363.7
	1 a. m. to 3 a. m...	9,328	.658	6.1	93.6	11.2	104.8	98.6	+ 1.3	99.9
	3 a. m. to 5 a. m...	9,328	.658	6.1	88.1	12.6	100.7	94.5	− .9	93.6
	5 a. m. to 7 a. m...	9,328	.658	6.1	85.1	10.6	95.7	89.5	+ 1.0	90.5
	Total, 6 hours	27,984	......	18.3	266.8	34.4	301.2	282.6	+ 1.4	284.0
	Total, 1 day..	113,490	......	79.9	1,101.9	162.4	1,264.3	1,184.2	+1,875.9	3,060.0
29–30.....	7 a. m. to 9 a. m...	9,328	.772	7.2	79.8	12.6	92.4	85.2	+ 147.9	233.1
	9 a. m. to 11 a. m..	8,551	.772	6.6	80.7	11.6	92.3	85.7	+ 324.0	409.7
	11 a. m. to 1 p. m..	9,328	.772	7.2	85.9	15.3	101.2	94.0	+ 271.9	365.9
	Total, 6 hours	27,207	......	21.0	246.4	39.5	285.9	264.9	+ 743.8	1,008.7
	1 p. m. to 3 p. m...	8,551	.777	6.6	83.6	11.7	95.3	88.7	+ 189.9	278.6
	3 p. m. to 5 p. m...	8,551	.777	6.6	88.6	12.7	101.3	94.7	+ 403.5	498.2
	5 p. m. to 7 p. m...	8,551	.777	6.6	95.9	11.9	107.8	101.2	+ 395.0	496.2
	Total, 6 hours	25,653	......	19.8	268.1	36.3	304.4	284.6	+ 988.4	1,273.0
	7 p. m. to 9 p. m...	8,551	.747	6.4	86.9	13.9	100.8	94.4	+ 45.3	139.7
	9 p. m. to 11 p. m..	10,105	.747	7.6	95.5	15.6	111.1	103.5	+ 44.7	148.2
	11 p. m. to 1 a. m..	10,105	.747	7.6	92.0	16.6	108.6	101.0	+ 20.6	121.6
	Total, 6 hours	28,761	......	21.6	274.4	46.1	320.5	298.9	+ 110.6	409.5
	1 a. m. to 3 a. m...	9,328	.727	6.8	93.5	13.9	107.4	100.6	+ 15.9	116.5
	3 a. m. to 5 a. m...	10,105	.727	7.3	96.6	16.9	113.5	106.2	+ 10.5	116.7
	5 a. m. to 7 a. m...	9,328	.727	6.8	89.2	12.4	101.6	94.9	+ 11.8	106.7
	Total, 6 hours	28.761	......	20.9	279.3	43.2	322.5	301.7	+ 38.2	339.9
	Total, 1 day..	110,382	......	83.3	1,068.2	165.1	1,233.3	1,150.1	+1,881.0	3,031.1
	Total, 3 days.	338,140	......	234.5	3,318.0	495.5	3,813.5	3,579.0	+6,026.1	9,605.1
	Experiment No. 50.									
30–31.....	7 a. m. to 9 a. m...	10,105	.732	7.4	80.1	15.9	96.0	88.6	+ 115.0	203.6
	9 a. m. to 11 a. m..	8,551	.732	6.3	92.3	15.8	108.1	101.8	+ 360.2	462.0
	11 a. m. to 1 p. m..	9,328	.732	6.8	93.1	17.5	110.6	103.8	+ 371.0	474.8
	Total, 6 hours	27,984	......	20.5	265.5	49.2	314.7	294.2	+ 846.2	1,140.4
	1 p. m. to 3 p. m...	9,328	.739	6.9	87.7	14.7	102.4	95.5	+ 191.5	287.0
	3 p. m. to 5 p. m...	9,328	.739	6.9	87.5	15.0	102.5	95.6	+ 50.3	145.9
	5 p. m. to 7 p. m...	10,105	.739	7.5	92.5	13.2	105.8	98.3	+ 49.4	147.7
	Total, 6 hours	28,761	......	21.3	267.7	42.9	310.7	289.4	+ 291.2	580.6

TABLE 120.—*Record of water in ventilating air current, etc.*—Continued.

Date.	Period.	(a) Ventilation (number of liters of air).	Water in incoming air. (b) Per liter.	Water in incoming air. (c) Total, $a \times b$.	Water in outgoing air. (d) Amount condensed in freezers.	Water in outgoing air. (e) Amount not condensed in freezers.	Water in outgoing air. (f) Total, $d+e$.	(g) Total excess water in outgoing air, $f-c$.	(h) Correction for water remaining in chamber.	(i) Total water of respiration and perspiration, $g+h$.
1902.	*Experiment No. 50*—Continued.	*Liters.*	*Mgs.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*
Mar. 30–31	7 p. m. to 9 p. m.	10,105	0.677	6.8	91.7	13.7	105.4	98.6	+ 10.9	109.5
	9 p. m. to 11 p. m.	9,328	.677	6.3	80.6	10.9	91.5	85.2	+ 14.2	99.4
	11 p. m. to 1 a. m.	10,105	.677	6.8	85.2	12.9	98.0	91.2	− 12.4	78.8
	Total, 6 hours	29,538	......	19.9	257.5	37.5	294.9	275.0	+ 12.7	287.7
	1 a. m. to 3 a. m.	9,328	.578	5.4	87.9	12.0	99.9	94.5	− 16.7	77.8
	3 a. m. to 5 a. m.	9,328	.578	5.4	84.7	13.0	97.7	92.3	− 16.3	76.0
	5 a. m. to 7 a. m.	9,328	.578	5.4	82.0	11.2	93.2	87.8	− 18.1	69.7
	Total, 6 hours	27,984	......	16.2	254.6	36.2	290.8	274.6	− 51.1	223.5
	Total, 1 day	114,267	......	77.9	1,045.3	165.8	1,211.1	1,133.2	+1,099.0	2,232.2
	Experiment No. 51.									
Mar. 31–Apr. 1.	7 a. m. to 9 a. m.	9,328	.597	5.6	77.2	12.4	89.6	84.1	+ 5.9	90.0
	9 a. m. to 11 a. m.	9,328	.597	5.6	74.4	10.1	84.5	79.0	+ 8.7	87.7
	11 a. m. to 1 p. m.	9,328	.597	5.6	76.6	11.4	88.0	82.4	+ 14.2	96.6
	Total, 6 hours	27,984	......	16.8	228.2	33.9	262.1	245.5	+ 28.8	274.3
	1 p. m. to 3 p. m.	9,328	.580	5.4	78.3	10.6	88.9	83.4	− 10.6	72.8
	3 p. m. to 5 p. m.	9,328	.580	5.4	78.7	10.8	89.5	84.1	− 5.7	78.4
	5 p. m. to 7 p. m.	9,328	.580	5.4	81.8	10.6	92.4	87.0	− 8.6	78.4
	Total, 6 hours	27,984	......	16.2	238.8	32.0	270.8	254.5	− 24.9	229.6
	7 p. m. to 9 p. m.	10,105	.600	6.1	88.2	13.8	102.0	96.0	− 2.7	93.3
	9 p. m. to 11 p. m.	9,328	.600	5.6	78.5	11.0	89.6	84.0	+ 2.3	86.2
	11 p. m. to 1 a. m.	10,105	.600	6.0	84.0	13.3	97.3	91.3	− 10.3	81.0
	Total, 6 hours	29,538	......	17.7	250.7	38.2	288.9	271.3	− 10.7	260.5
	1 a. m. to 3 a. m.	10,105	.597	6.0	88.3	11.4	99.7	93.6	− 3.0	90.6
	3 a. m. to 5 a. m.	9,328	.597	5.6	79.9	10.6	90.5	84.9	− 1.9	83.0
	5 a. m. to 7 a. m.	9,328	.597	5.6	80.3	10.0	90.3	84.7	− 4.8	79.9
	Total, 6 hours	28,761	......	17.2	248.5	32.0	280.5	263.2	− 9.7	253.6
	Total, 1 day	114,267	......	67.9	966.2	136.1	1,102.3	1,034.5	− 16.5	1,018.0
Apr. 1–2	7 a. m. to 9 a. m.	9,328	.595	5.5	83.8	11.8	95.6	90.0	+ 12.1	102.1
	9 a. m. to 11 a. m.	10,105	.595	6.0	85.4	11.9	97.3	91.3	+ 7.6	98.9
	11 a. m. to 1 p. m.	9,328	.595	5.5	75.2	12.3	87.5	81.9	+ 8.8	90.7
	Total, 6 hours	28,761	......	17.0	244.4	36.0	280.4	263.2	+ 28.5	291.7
	1 p. m. to 3 p. m.	8,551	.593	5.1	68.7	9.7	77.8	72.7	− 6.4	66.3
	3 p. m. to 5 p. m.	9,328	.593	5.5	71.8	11.3	83.1	77.6	− 6.3	71.3
	5 p. m. to 7 p. m.	10,105	.593	6.0	76.7	11.6	88.3	82.3	− 3.2	79.1
	Total, 6 hours	27,984	......	16.6	216.6	32.6	249.2	232.6	− 15.9	216.7

TABLE 120.—*Record of water in ventilating air current, etc.*—Continued.

Date.	Period.	(*a*)	Water in incoming air.		Water in outgoing air.			(*g*)	(*h*)	(*i*)
		Ventilation (number of liters of air).	(*b*) Per liter.	(*c*) Total, *a*×*b*.	(*d*) Amount condensed in freezers.	(*e*) Amount not condensed in freezers.	(*f*) Total, *d*+*e*.	Total excess water in outgoing air, *f*−*c*.	Correction for water remaining in chamber.	Total water of respiration and perspiration, *g*+*h*.
1902.	*Experiment No. 51*—Continued.	*Liters.*	*Mgs.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*
Apr. 1–2	7 p. m. to 9 p. m.	10,105	0.585	5.9	77.8	13.0	90.8	84.9	− 18.0	66.9
	9 p. m. to 11 p. m.	9,328	.585	5.5	68.2	10.5	78.7	73.2	− 12.0	61.2
	11 p. m. to 1 a. m.	10,105	.585	5.9	75.2	12.2	87.4	81.4	− 14.3	67.1
	Total, 6 hours	29,538	......	17.3	221.2	35.7	256.9	239.5	− 44.3	195.2
	1 a. m. to 3 a. m.	9,328	.556	5.2	72.3	10.0	82.3	77.2	− 14.0	63.2
	3 a. m. to 5 a. m.	9,328	.556	5.2	70.0	10.9	80.9	75.7	− 15.0	60.7
	5 a. m. to 7 a. m.	10,105	.556	5.6	76.2	11.1	87.3	81.7	− 14.0	67.7
	Total, 6 hours	28,761	......	16.0	218.5	32.0	250.5	234.6	− 43.0	191.6
	Total, 1 day	115,044	......	66.9	900.7	136.3	1,037.0	969.9	− 74.7	895.2
	Total, 2 days	229,311	......	134.8	1,866.9	272.4	2,139.3	2,004.4	− 91.2	1,913.2
	Experiment No. 52.									
21–22	7 a. m. to 9 a. m.	9,328	1.327	12.4	76.7	22.0	98.7	86.3	+ 161.2	247.5
	9 a. m. to 11 a. m.	9,328	1.327	12.4	94.3	22.0	116.3	103.9	+ 374.5	478.4
	11 a. m. to 1 p. m.	9,328	1.327	12.4	88.8	28.8	117.6	105.2	+ 406.0	511.2
	Total, 6 hours	27,984	......	37.2	259.8	72.8	332.6	295.4	+ 941.7	1,237.1
	1 p. m. to 3 p. m.	9,328	1.708	15.9	97.7	22.1	119.8	103.9	+ 331.9	435.8
	3 p. m. to 5 p. m.	9,328	1.708	15.9	94.8	28.4	123.2	107.3	+ 596.4	703.7
	5 p. m. to 7 p. m.	9,328	1.708	15.9	102.6	28.5	131.1	115.2	+ 453.4	568.6
	Total, 6 hours	27,984	......	47.7	295.1	79.0	374.1	326.4	+1,381.7	1,708.1
	7 p. m. to 9 p. m.	10,105	1.589	16.1	92.4	37.4	129.8	113.7	+ 58.5	172.2
	9 p. m. to 11 p. m.	10,105	1.589	16.1	97.1	25.3	122.4	106.3	+ 22.5	128.8
	11 p. m. to 1 a. m.	10,105	1.589	16.1	99.1	23.7	122.8	106.7	+ 17.0	123.7
	Total, 6 hours	30,315	......	48.3	288.6	86.4	375.0	326.7	+ 98.0	424.7
	1 a. m. to 3 a. m.	9,328	1.287	12.0	88.8	21.6	110.4	98.4	+ 11.1	109.5
	3 a. m. to 5 a. m.	9,328	1.287	12.0	82.5	23.2	105.7	93.7	+ 8.6	102.3
	5 a. m. to 7 a. m.	9,328	1.287	12.0	86.7	17.4	104.1	92.1	+ 13.7	105.8
	Total, 6 hours	27,984	......	36.0	258.0	62.2	320.2	284.2	+ 33.4	317.6
	Total, 1 day	114,267	......	169.2	1,101.5	300.4	1,401.9	1,232.7	+2,454.8	3,687.5
22–23	7 a. m. to 9 a. m.	9,328	.997	9.3	86.1	17.9	104.0	94.7	+ 158.3	253.0
	9 a. m. to 11 a. m.	9,328	.997	9.3	101.9	17.9	119.8	110.5	+ 454.9	565.4
	11 a. m. to 1 p. m.	9,328	.997	9.3	105.0	19.5	124.5	115.2	+ 406.0	521.2
	Total, 6 hours	27,984	......	27.9	293.0	55.3	348.3	320.4	+1,019.2	1,339.6
	1 p. m. to 3 p. m.	8,551	.843	7.2	88.3	15.5	103.8	96.6	+ 254.4	351.0
	3 p. m. to 5 p. m.	9,328	.843	7.9	100.1	17.9	118.0	110.1	+ 483.4	593.5
	5 p. m. to 7 p. m.	8,551	.843	7.2	100.8	14.5	115.3	108.1	+ 351.1	459.2
	Total, 6 hours	26,430	......	22.3	289.2	47.9	337.1	314.8	+1,088.9	1,403.7

TABLE 120.—*Record of water in ventilating air current, etc.*—Continued.

Date.	Period.	(a) Ventilation (number of liters of air).	Water in incoming air. (b) Per liter.	(c) Total, $a \times b$.	Water in outgoing air. (d) Amount condensed in freezers.	(e) Amount not condensed in freezers.	(f) Total, $d+e$.	(g) Total excess water in outgoing air, $f-c$.	(h) Correction for water remaining in chamber.	(i) Total water of respiration and perspiration, $g+h$.
1902.	*Experiment No. 52*—Continued.	*Liters.*	*Mgs.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*
Apr. 22–23.....	7 p. m. to 9 p. m...	10,105	0.704	7.1	102.4	17.5	119.9	112.8	+ 60.1	172.9
	9 p. m. to 11 p. m..	10,105	.704	7.1	100.0	14.7	114.7	107.6	+ 23.5	131.1
	11 p. m. to 1 a. m..	9,328	.704	6.6	89.5	14.2	103.7	97.1	+ 2.2	99.3
	Total, 6 hours	29,538	......	20.8	291.9	46.4	338.3	317.5	+ 85.8	403.3
	1 a. m. to 3 a. m...	10,105	.763	7.7	100.7	13.8	114.5	106.8	− 5.6	101.2
	3 a. m. to 5 a. m...	9,328	.763	7.1	84.2	14.3	98.5	91.4	− 7.9	83.5
	5 a. m. to 7 a. m...	9,328	.763	7.1	82.6	13.3	95.9	88.8	− 2.7	86.1
	Total, 6 hours	28,761	......	21.9	267.5	41.4	308.9	287.0	− 16.2	270.8
	Total, 1 day..	112,713	......	92.9	1,141.6	191.0	1,332.6	1,239.7	+2,177.7	3,417.4
23–24.....	7 a. m. to 9 a. m...	9,328	.917	8.6	82.5	14.9	97.4	88.8	+ 203.3	292.1
	9 a. m. to 11 a. m..	9,328	.917	8.6	97.6	17.0	114.6	106.0	+ 440.3	546.3
	11 a. m. to 1 p. m..	9,328	.917	8.6	99.2	19.8	119.0	110.4	+ 392.7	503.1
	Total, 6 hours	27,984	......	25.8	279.3	51.7	331.0	305.2	+1,036.3	1,341.5
	1 p. m. to 3 p. m...	9,328	1.048	9.8	99.0	16.8	115.8	106.0	+ 236.6	342.6
	3 p. m. to 5 p. m...	8,551	1.048	8.9	87.8	18.6	106.4	97.5	+ 522.0	619.5
	5 p. m. to 7 p. m...	9,328	1.048	9.8	102.3	19.4	121.7	111.9	+ 378.1	490.0
	Total, 6 hours	27,207	......	28.5	289.1	54.8	343.9	315.4	+1,136.7	1,452.1
	7 p. m. to 9 p. m...	10,105	1.166	11.8	95.9	23.6	119.5	107.7	+ 44.8	152.5
	9 p. m. to 11 p. m..	10,105	1.166	11.8	92.5	20.3	112.8	101.0	+ 33.3	134.3
	11 p. m. to 1 a. m..	9,328	1.166	10.8	90.1	20.9	111.0	100.2	+ 20.4	120.6
	Total, 6 hours	29,538	......	34.4	278.5	64.8	343.3	308.9	+ 98.5	407.4
	1 a. m. to 3 a. m...	9,328	.876	8.2	94.0	17.2	111.2	103.0	+ 6.4	109.4
	3 a. m. to 5 a. m...	9,328	.876	8.2	91.6	17.3	108.9	100.7	+ 10.1	110.8
	5 a. m. to 7 a. m...	10,105	.876	8.8	94.0	15.1	109.1	100.3	+ 11.2	111.5
	Total, 6 hours	28,761	......	25.2	279.6	49.6	329.2	304.0	+ 27.7	331.7
	Total, 1 day .	113,490	......	113.9	1,126.5	220.9	1,347.4	1,233.5	+2,299.2	3,532.7
	Total, 3 days.	340,470	......	376.0	3,369.6	712.3	4,081.9	3,705.9	+6,931.7	10,637.6
	Experiment No. 53.									
24–25.....	7 a. m. to 9 a. m...	9,328	.964	9.0	86.2	15.5	101.7	92.7	+ 132.1	224.8
	9 a. m. to 11 a. m..	8,551	.964	8.2	79.3	14.5	93.8	85.6	+ 386.5	472.1
	11 a. m. to 1 p. m..	9,328	.964	9.0	89.7	18.7	108.4	99.4	+ 375.3	474.7
	Total, 6 hours	27,207	......	26.2	255.2	48.7	303.9	277.7	+ 893.9	1,171.6
	1 p. m. to 3 p. m...	8,551	.916	7.8	81.1	14.6	95.7	87.9	+ 205.8	293.7
	3 p. m. to 5 p. m...	9,328	.916	8.6	92.8	16.6	109.4	100.8	+ 386.8	487.6
	5 p. m. to 7 p. m...	9,328	.916	8.6	101.1	15.7	116.8	108.2	+ 357.1	465.3
	Total, 6 hours	27,207	......	25.0	275.0	46.9	321.9	296.9	+ 949.7	1,246.6

TABLE 120.—*Record of water in ventilating air current, etc.*—Continued.

Date.	Period.	(*a*) Ventilation (number of liters of air).	Water in incoming air. (*b*) Per liter.	(*c*) Total, $a \times b$.	Water in outgoing air. (*d*) Amount condensed in freezers.	(*e*) Amount not condensed in freezers.	(*f*) Total, $d+e$.	(*g*) Total excess water in outgoing air, $f-c$.	(*h*) Correction for water remaining in chamber.	(*i*) Total water of respiration and perspiration, $g+h$.
	Experiment No. 53—Continued.									
1902.		*Liters.*	*Mgs.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*
Apr. 24–25.....	7 p. m. to 9 p. m...	9,328	0.738	6.9	87.7	15.9	103.6	96.7	+ 31.4	128.1
	9 p. m. to 11 p. m..	9,328	.738	6.9	86.8	13.6	100.4	93.5	+ 50.3	143.8
	11 p. m. to 1 a. m..	10,105	.738	7.4	101.5	16.6	118.1	110.7	+ 12.0	122.7
	Total, 6 hours	28,761	......	21.2	276.0	46.1	322.1	300.9	+ 93.7	394.6
	1 a. m. to 3 a. m...	9,328	.717	6.7	98.5	13.7	112.2	105.5	+ 4.1	109.6
	3 a. m. to 5 a. m...	9,328	.717	6.7	98.6	15.8	114.4	107.7	+ 3.5	111.2
	5 a. m. to 7 a. m...	9,328	.717	6.7	90.3	14.4	104.7	98.0	+ 3.7	101.7
	Total, 6 hours	27,984	......	20.1	287.4	43.9	331.3	311.2	+ 11.3	322.5
	Total, 1 day .	111,159	......	92.5	1,093.6	185.6	1,279.2	1,186.7	+1,948.6	3,135.3
25–26.....	7 a. m. to 9 a. m...	9,328	.979	9.1	86.7	15.9	102.6	93.5	+ 177.5	271.0
	9 a. m. to 11 a. m..	9,328	.979	9.1	92.5	17.3	109.8	100.7	+ 452.2	552.9
	11 a. m. to 1 p. m..	8,551	.979	8.4	84.8	17.7	102.5	94.1	+ 401.3	495.4
	Total, 6 hours	27,207	......	26.6	264.0	50.9	314.9	288.3	+1,031.0	1,319.3
	1 p. m. to 3 p. m...	9,328	.844	7.9	91.7	15.3	107.0	99.1	+ 202.4	301.5
	3 p. m. to 5 p. m...	9,328	.844	7.9	100.8	16.1	116.9	109.0	+ 491.2	600.2
	5 p. m. to 7 p. m...	9,328	.844	7.9	103.5	15.5	119.0	111.1	+ 375.2	486.3
	Total, 6 hours	27,984	......	23.7	296.0	46.9	342.9	319.2	+1,068.8	1,388.0
	7 p. m. to 9 p. m...	9,328	.760	7.1	90.9	15.5	106.4	99.3	+ 32.2	131.5
	9 p. m. to 11 p. m..	10,105	.760	7.7	96.7	15.1	111.8	104.1	+ 27.0	131.1
	11 p. m. to 1 a. m..	10,105	.760	7.7	98.1	17.0	115.1	107.4	− 5.4	102.0
	Total, 6 hours	29,538	......	22.5	285.7	47.6	333.3	310.8	+ 53.8	364.6
	1 a. m. to 3 a. m...	9,328	.768	7.2	91.2	14.7	105.9	98.7	− 12.2	86.5
	3 a. m. to 5 a. m...	10,105	.768	7.7	90.3	16.9	107.2	99.5	− 11.0	88.5
	5 a. m. to 7 a. m...	9,328	.768	7.2	81.3	14.2	95.5	88.3	− 11.6	76.7
	Total, 6 hours	28,761	......	22.1	262.8	45.8	308.6	286.5	− 34.8	251.7
	Total, 1 day..	113,490	......	94.9	1,108.5	191.2	1,299.7	1,204.8	+2,118.8	3,323.6
26–27.....	7 a. m. to 9 a. m...	9,328	.992	9.3	82.7	14.7	97.4	88.1	+ 149.5	237.6
	9 a. m. to 11 a. m..	9,328	.992	9.3	95.8	17.6	113.4	104.1	+ 496.8	600.9
	11 a. m. to 1 p. m..	10,105	.992	10.0	100.1	22.4	122.5	112.5	+ 396.8	509.3
	Total, 6 hours	28,761	......	28.6	278.6	54.7	333.3	304.7	+1,043.1	1,347.8
	1 p. m. to 3 p. m...	9,328	1.040	9.7	91.8	16.5	108.3	98.6	+ 248.9	347.5
	3 p. m. to 5 p. m...	9,328	1.040	9.7	96.1	18.1	114.2	104.5	+ 507.7	612.2
	5 p. m. to 7 p. m...	9,328	1.040	9.7	99.3	17.2	116.5	106.8	+ 307.1	413.9
	Total, 6 hours	27,984	......	29.1	287.2	51.8	339.0	309.9	+1,063.7	1,373.6
	7 p. m. to 9 p. m...	9,328	.868	8.1	93.9	17.0	110.9	102.8	+ 24.0	126.8
	9 p. m. to 11 p. m..	10,105	.868	8.8	95.9	16.6	112.5	103.7	+ 32.7	136.4
	11 p. m. to 1 a. m..	9,328	.868	8.1	91.7	14.5	106.2	98.1	+ 6.6	104.7
	Total, 6 hours	28,761	......	25.0	281.5	48.1	329.6	304.6	+ 63.3	367.9

TABLE 120.—*Record of water in ventilating air current, etc.*—Continued.

Date.	Period.	(a) Ventilation (number of liters of air).	Water in incoming air. (b) Per liter.	(c) Total, $a \times b$.	Water in outgoing air. (d) Amount condensed in freezers.	(e) Amount not condensed in freezers.	(f) Total, $d+e$.	(g) Total excess water in outgoing air, $f-c$.	(h) Correction for water remaining in chamber.	(i) Total water of respiration and perspiration, $g+h$.
	Experiment No. 53—Continued.									
1902.		*Liters.*	*Mgs.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*
Apr. 26–27	1 a. m. to 3 a. m	9,328	0.854	8.0	93.2	13.4	106.6	98.6	− 1.6	97.0
	3 a. m. to 5 a. m	9,328	.854	8.0	90.7	14.8	105.5	97.5	+ 3.9	101.4
	5 a. m. to 7 a. m	9,328	.854	8.0	83.2	15.3	98.5	90.5	− 3.4	87.1
	Total, 6 hours	27,984	......	24.0	267.1	43.5	310.6	286.6	− 1.1	285.5
	Total, 1 day	113,490	......	106.7	1,114.4	198.1	1,312.5	1,205.8	+2,169.0	3,374.8
	Total, 3 days	338,139	......	294.1	3,316.5	574.9	3,891.4	3,597.3	+6,236.4	9,833.7
	Experiment No. 54.									
27–28	7 a. m. to 9 a. m	9,328	1.277	11.9	79.2	17.7	96.9	85.0	+ 157.5	242.5
	9 a. m. to 11 a. m	9,328	1.277	11.9	88.3	19.9	108.2	96.3	+ 433.6	529.9
	11 a. m. to 1 p. m	9,328	1.277	11.9	83.0	24.1	107.1	95.2	+ 379.8	475.0
	Total, 6 hours	27,984	......	35.7	250.5	61.7	312.2	276.5	+ 970.9	1,247.4
	1 p. m. to 3 p. m	8,551	1.285	11.0	78.8	17.4	96.2	85.2	+ 203.6	288.8
	3 p. m. to 5 p. m	9,328	1.285	12.0	92.9	22.4	115.3	103.3	+ 476.1	579.4
	5 p. m. to 7 p. m	8,551	1.285	11.0	88.7	20.3	109.0	98.0	+ 390.6	488.6
	Total, 6 hours	26,430	......	34.0	260.4	60.1	320.5	286.5	+1,070.3	1,356.8
	7 p. m. to 9 p. m	9,328	1.007	9.4	86.8	20.7	107.5	98.1	+ 26.9	125.0
	9 p. m. to 11 p. m	10,105	1.007	10.2	94.0	19.3	113.3	103.1	+ 35.3	138.4
	11 p. m. to 1 a. m	9,328	1.007	9.4	90.8	17.1	107.9	98.5	+ 14.8	113.3
	Total, 6 hours	28,761	......	29.0	271.6	57.1	328.7	299.7	+ 77.0	376.7
	1 a. m. to 3 a. m	10,105	.764	7.7	107.0	15.4	122.4	114.7	+ 4.7	119.4
	3 a. m. to 5 a. m	9,328	.764	7.1	90.6	14.8	105.4	98.3	+ 4.1	102.4
	5 a. m. to 7 a. m	9,328	.764	7.1	84.8	12.8	97.6	90.5	+ 4.4	94.9
	Total, 6 hours	28,761	......	21.9	282.4	43.0	325.4	303.5	+ 13.2	316.7
	Total, 1 day	111,936	......	120.6	1,064.9	221.9	1,286.8	1,166.2	+2,131.4	3,297.6
28–29	7 a. m. to 9 a. m	10,105	1.057	10.7	97.0	16.8	113.8	103.1	+ 203.9	307.0
	9 a. m. to 11 a. m	9,328	1.057	9.9	95.2	16.7	111.9	102.0	+ 522.3	624.3
	11 a. m. to 1 p. m	7,774	1.057	8.2	74.8	17.5	92.3	84.1	+ 436.4	520.5
	Total, 6 hours	27,207	......	28.8	267.0	51.0	318.0	289.2	+1,162.6	1,451.8
	1 p. m. to 3 p. m	9,328	1.962	18.3	107.2	24.8	132.0	113.7	+ 212.7	326.4
	3 p. m. to 5 p. m	9,328	1.962	18.3	62.9	29.9	92.8	74.5	+ 577.6	652.1
	5 p. m. to 7 p. m	6,996	1.962	13.7	68.6	20.9	89.5	75.8	+ 278.9	354.7
	Total, 6 hours	25,652	......	50.3	238.7	75.6	314.3	264.0	+1,069.2	1,333.2
	7 p. m. to 9 p. m	10,105	1.385	14.0	86.4	30.4	116.8	102.8	+ 29.0	131.8
	9 p. m. to 11 p. m	10,105	1.385	14.0	81.9	24.6	106.5	92.5	+ 33.0	125.5
	11 p. m. to 1 a. m	9,328	1.385	12.9	84.1	21.6	105.7	92.8	+ 9.6	102.4
	Total, 6 hours	29,538	......	40.9	252.4	76.6	329.0	288.1	+ 71.6	359.7

TABLE 120.—*Record of water in ventilating air current, etc.*—Continued.

Date.	Period.	(a) Ventilation (number of liters of air).	Water in incoming air. (b) Per liter.	Water in incoming air. (c) Total, a×b.	Water in outgoing air. (d) Amount condensed in freezers.	Water in outgoing air. (e) Amount not condensed in freezers.	Water in outgoing air. (f) Total, d+e.	(g) Total excess water in outgoing air, f−c.	(h) Correction for water remaining in chamber.	(i) Total water of respiration and perspiration, g+h.
1902.	*Experiment No. 54*—Continued.	*Liters.*	*Mgs.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*	*Gms.*
Apr. 28–29	1 a. m. to 3 a. m	9,328	1.094	10.2	90.8	18.2	109.0	98.8	+ 3.6	102.4
	3 a. m. to 5 a. m	10,105	1.094	11.0	89.1	22.6	111.7	100.7	+ .8	101.5
	5 a. m. to 7 a. m	9,328	1.094	10.2	82.0	16.6	98.6	88.4	+ 1.2	89.6
	Total, 6 hours	28,761	......	31.4	261.9	57.4	319.3	287.9	+ 5.6	293.5
	Total, 1 day	111,158	......	151.4	1,020.0	260.6	1,280.6	1,129.2	+2,309.0	3,438.2
29–30	7 a. m. to 9 a. m	9,328	1.178	11.0	80.6	18.4	99.0	88.0	+ 204.4	292.4
	9 a. m. to 11 a. m	9,328	1.178	11.0	96.8	19.9	116.7	105.7	+ 513.0	618.7
	11 a. m. to 1 p. m	9,328	1.178	11.0	94.6	21.3	115.9	104.9	+ 464.2	569.1
	Total, 6 hours	27,984	......	33.0	272.0	59.6	331.6	298.6	+1,181.6	1,480.2
	1 p. m. to 3 p. m	9,328	1.090	10.2	92.4	16.7	109.1	98.9	+ 242.5	341.4
	3 p. m. to 5 p. m	9,328	1.090	10.2	92.0	19.5	111.5	101.3	+ 386.7	488.0
	5 p. m. to 7 p. m	9,328	1.090	10.2	101.8	18.8	120.6	110.4	+ 339.7	450.1
	Total, 6 hours	27,984	......	30.6	286.2	55.0	341.2	310.6	+ 968.9	1,279.5
	7 p. m. to 9 p. m	10,105	.994	10.0	107.0	21.0	128.0	118.0	+ 33.2	151.2
	9 p. m. to 11 p. m	9,328	.994	9.3	96.2	16.3	112.5	103.2	+ 54.7	157.9
	11 p. m. to 1 a. m	9,328	.994	9.3	93.7	16.9	110.6	101.3	− 4.3	97.0
	Total, 6 hours	28,761	......	28.6	296.9	54.2	351.1	322.5	+ 83.6	406.1
	1 a. m. to 3 a. m	10,105	.952	9.6	100.5	15.8	116.3	106.7	− 4.5	102.2
	3 a. m. to 5 a. m	9,328	.952	8.9	101.0	15.7	116.7	107.8	− 8.3	99.5
	5 a. m. to 7 a. m	9,328	.952	8.9	84.5	14.8	99.3	90.4	− 7.8	82.6
	Total, 6 hours	28,761	......	27.4	286.0	46.3	332.3	304.9	− 20.6	284.3
	Total, 1 day	113,490	......	119.6	1,141.1	215.1	1,356.2	1,236.6	+2,213.5	3,450.1
	Total, 3 days	336,584	......	391.6	3,226.0	697.6	3,923.6	3,532.0	+6,653.9	10,185.9
	Experiment No. 55.									
30–May 1	7 a. m. to 9 a. m	9,328	1.239	11.6	101.4	16.9	118.3	106.7	+ 432.3	539.0
	9 a. m. to 11 a. m	9,328	1.239	11.6	109.1	19.9	129.0	117.4	+ 709.9	827.3
	11 a. m. to 1 p. m	10,105	1.239	12.5	116.7	26.0	142.7	130.2	+ 556.2	686.4
	Total, 6 hours	28,761	......	35.7	327.2	62.8	390.0	354.3	+1,698.4	2,052.7
	1 p. m. to 3 p. m	10,105	1.380	13.9	121.2	21.4	142.6	128.7	+ 450.8	579.5
	3 p. m. to 5 p. m	9,328	1.380	12.9	110.3	23.9	134.2	121.3	+ 717.7	839.0
	5 p. m. to 7 p. m	10,883	1.380	15.0	129.8	28.0	157.8	142.8	+ 514.1	656.9
	Total, 6 hours	30,316	......	41.8	361.3	73.3	434.6	392.8	+1,682.6	2,075.4
	7 p. m. to 9 p. m	10,105	1.852	18.7	107.3	33.4	140.7	122.0	+ 474.3	596.3
	9 p. m. to 11 p. m	10,883	1.852	20.2	122.6	32.6	155.2	135.0	+ 679.3	814.3
	11 p. m. to 1 a. m	10,105	1.852	18.7	103.7	29.8	133.5	114.8	+ 356.3	471.1
	Total, 6 hours	31,093	......	57.6	333.6	95.8	429.4	371.8	+1,509.9	1,881.7
	1 a. m. to 3 a. m	10,105	1.540	15.6	108.2	28.3	136.5	120.9	+ 336.3	457.2
	3 a. m. to 5 a. m	10,883	1.540	16.7	118.8	28.4	147.2	130.5	+ 335.3	465.8
	5 a. m. to 7 a. m	10,105	1.540	15.6	103.1	25.0	128.1	112.5	+ 335.7	448.2
	Total, 6 hours	31,093	......	47.9	330.1	81.7	411.8	363.9	+1,007.3	1,371.2
	Total, 1 day	121,263	......	183.0	1,352.2	313.6	1,665.8	1,482.8	+5,898.2	7,381.0

TABLE 121.—*Water eliminated from lungs and skin by 2-hour periods, metabolism experiments Nos. 35–55, inclusive.*

Kind and number of experiment.	Day.	7 a. m. to 9 a. m.	9 a. m. to 11 a. m.	11 a. m. to 1 p. m.	Total, 6 hours.	1 p. m. to 3 p. m.	3 p. m. to 5 p. m.	5 p. m. to 7 p. m.	Total, 6 hours.	7 p. m. to 9 p. m.	9 p. m. to 11 p. m.	11 p. m. to 1 a. m.	Total, 6 hours.	1 a. m. to 3 a. m.	3 a. m. to 5 a. m.	5 a. m. to 7 a. m.	Total, 6 hours.	Total, 1 day.
Rest experiments, without food.		*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
No. 36	1	73.3	61.6	59.6	194.5	64.4	59.3	62.6	186.3	64.0	61.3	66.4	191.7	64.2	66.0	65.4	195.6	768.1
No. 39	1	89.5	65.5	53.0	208.0	67.7	55.0	55.6	178.3	53.2	69.1	74.8	197.1	84.3	75.6	79.0	238.9	822.3
No. 42	1	84.4	63.5	76.9	224.8	58.6	66.2	69.1	193.9	74.0	73.7	71.0	218.7	66.0	68.1	70.2	204.3	841.7
No. 51	1	90.0	87.7	96.6	274.3	72.8	78.4	78.4	229.6	93.3	86.2	81.0	260.5	90.7	83.0	79.9	253.6	1,018.0
	2	102.2	98.9	90.7	291.8	66.3	71.3	79.1	216.7	66.9	61.2	67.1	195.2	63.2	60.7	67.7	191.6	895.3
Average per day		96.1	93.3	93.7	283.1	69.6	74.8	78.8	223.2	80.1	73.7	74.0	227.8	76.9	71.9	73.8	222.6	956.7
Average, Nos. 36, 39, 42, 51		87.9	75.4	75.4	238.7	66.0	66.0	69.0	201.0	70.3	70.3	72.0	212.6	73.7	70.7	72.4	216.8	869.1
Rest experiments, with food.																		
No. 35	1	99.3	86.9	81.5	267.7	85.4	83.9	86.1	255.4	80.0	83.7	70.9	234.6	74.7	50.8	71.1	196.6	954.3
No. 35	2	85.1	70.4	75.2	230.7	74.9	73.6	78.0	226.5	68.0	71.1	[a] 73.4	212.5	66.1	66.1	67.9	200.1	869.8
No. 35	3	83.1	71.9	62.8	217.8	70.7	68.7	80.8	220.2	74.2	71.4	67.9	213.5	69.7	70.6	71.1	211.4	862.9
No. 35	4	74.3	68.7	69.5	212.5	72.2	72.6	72.3	217.1	63.9	70.5	[a] 71.2	205.6	65.9	67.3	68.6	201.8	837.0
Average per day		85.5	74.5	72.2	232.2	75.8	74.7	79.3	229.8	71.5	74.2	70.8	216.5	69.1	63.7	69.7	202.5	881.0
Work experiments, conditions exceptional.																		
No. 50	1	203.6	462.0	474.8	1,140.4	287.0	[b] 145.9	147.7	580.6	109.5	99.4	78.8	287.7	77.8	76.0	69.7	223.5	2,232.2
No. 55	1	539.0	827.3	686.4	2,052.7	579.5	839.0	656.9	2,075.4	596.3	814.3	471.1	1,881.7	[c] 457.2	465.8	448.2	1,371.2	7,381.0
Work experiments, carbohydrate diet.																		
No. 37	1	222.2	529.6	337.5	1,089.3	190.2	394.8	330.0	915.0	118.6	99.8	73.8	292.2	77.5	68.3	69.4	215.2	2,511.7
No. 37	2	261.5	460.0	507.3	1,228.8	356.2	519.0	417.8	1,293.0	121.9	114.0	68.2	304.1	68.2	62.3	67.9	198.4	3,024.3

[a] On these nights the supper was eaten at 10.45 p. m.

[b] In this experiment the subject stopped work at 3 p. m.

[c] In this experiment the subject was off the bicycle from 1 a. m. to 4.13 a. m.

TABLE 121.—*Water eliminated from lungs and skin by 2-hour periods, metabolism experiments Nos. 35–55, inclusive*—Continued.

Kind and number of experiment.	Day.	7 a. m. to 9 a. m.	9 a. m. to 11 a.m.	11 a. m. to 1 p. m.	Total, 6 hours.	1 p. m. to 3 p. m.	3 p. m. to 5 p. m.	5 p. m. to 7 p. m.	Total, 6 hours.	7 p. m. to 9 p. m.	9 p. m. to 11 p. m.	11 p. m. to 1 a. m.	Total, 6 hours.	1 a.m. to 3 a. m.	3 a. m. to 5 a. m.	5 a. m. to 7 a. m.	Total, 6 hours.	Total, 1 day.
Work experiments, carbohydrate diet—Continued.		*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
No. 37	3	262.3	451.0	494.7	1,208.0	303.6	513.2	353.3	1,170.1	109.4	92.1	70.1	271.6	71.5	60.2	61.6	193.3	2,843.0
No. 37	4	183.9	392.0	334.0	909.9	237.4	401.0	303.0	941.4	101.5	95.1	73.6	270.2	62.3	60.1	66.8	189.2	2,310.7
Average per day	......	232.5	458.1	418.4	1,109.0	271.9	457.0	351.0	1,079.9	112.9	100.2	71.4	284.5	69.9	62.7	66.4	199.0	2,672.4
No. 40	1	270.5	543.0	540.9	1,354.4	371.9	572.0	421.3	1,365.2	109.1	101.7	92.0	302.8	86.8	83.7	85.8	256.3	3,278.7
No. 40	2	226.5	516.4	477.3	1,220.2	316.6	565.0	466.2	1,347.8	96.1	143.3	80.6	320.0	70.7	66.9	62.0	199.6	3,087.6
No. 40	3	248.9	546.1	464.7	1,259.7	320.6	521.5	425.2	1,267.3	107.2	108.7	79.7	295.6	78.6	69.1	71.8	219.5	3,042.1
No. 40	4	238.7	520.3	491.7	1,250.7	276.9	549.0	484.4	1,310.3	107.7	106.4	79.8	293.9	73.9	71.3	68.1	213.3	3,068.2
Average per day	......	246.1	531.5	493.6	1,271.2	321.5	551.9	449.3	1,322.7	105.0	115.1	83.0	303.1	77.5	72.8	71.9	222.2	3,119.2
No. 44	1	256.8	464.9	439.4	1,161.1	306.0	528.2	590.2	1,424.4	117.8	129.4	89.2	336.4	86.4	82.3	82.5	251.2	3,173.1
No. 44	2	237.2	456.3	431.3	1,124.8	313.4	560.5	479.7	1,353.6	156.0	101.0	73.1	330.1	73.1	76.1	77.1	226.3	3,034.8
No. 44	3	240.2	483.5	447.1	1,170.8	350.7	612.5	442.3	1,405.5	132.9	106.1	71.3	310.3	71.4	67.9	71.8	211.1	3,097.7
No. 44	4	283.6	572.6	531.7	1,387.9	384.8	599.8	569.4	1,554.0	135.5	129.9	91.7	357.1	92.6	92.2	91.5	276.3	3,575.3
Average per day	......	254.4	494.3	462.4	1,211.1	338.7	575.3	520.4	1,434.4	135.6	116.6	81.3	333.5	80.9	79.6	80.7	241.2	3,220.2
No. 47	1	313.5	647.2	603.9	1,564.6	400.2	631.1	511.6	1,542.9	131.7	119.9	114.7	366.3	110.6	104.3	94.6	309.5	3,783.3
No. 47	2	308.5	657.7	590.7	1,556.9	393.0	590.5	516.3	1,499.8	145.8	143.5	110.6	399.9	95.5	94.5	73.1	263.1	3,719.7
No. 47	3	326.2	674.8	599.5	1,600.5	385.5	582.3	494.6	1,462.4	153.5	150.5	114.4	418.4	98.4	102.4	89.3	290.1	3,771.4
No. 47	4	352.1	679.1	599.7	1,630.9	397.0	680.3	582.2	1,659.5	147.5	153.2	115.0	415.7	113.6	107.1	97.2	317.9	4,024.0
Average per day	......	325.1	664.7	598.4	1,588.2	393.9	621.1	526.2	1,541.2	144.6	141.8	113.7	400.1	104.5	102.1	88.5	295.1	3,824.6
No. 49	1	314.1	469.3	424.7	1,208.1	383.8	621.5	584.1	1,589.4	175.7	129.1	108.8	413.6	105.7	98.6	98.6	302.9	3,514.0
No. 49	2	217.3	512.9	425.5	1,155.7	320.7	545.9	390.1	1,256.7	140.9	124.2	98.7	363.8	99.9	93.6	90.5	284.0	3,060.2
No. 49	3	233.0	409.7	365.9	1,008.6	278.6	498.1	496.2	1,272.9	139.8	148.2	121.6	409.6	116.5	116.7	106.6	339.8	3,030.9
Average per day	......	254.8	464.0	405.4	1,124.2	327.7	555.2	490.1	1,373.0	152.1	133.8	109.7	395.6	107.4	103.0	98.5	308.9	3,201.7

No. 53	1	221.8	472.1	474.7	1,171.6	293.7	487.6	465.3	1,246.6	128.1	143.8	122.7	394.6	109.6	111.2	101.7	322.5	3,135.3
No. 53	2	271.0	552.9	495.4	1,319.3	301.5	600.2	486.3	1,388.0	131.5	131.1	102.0	364.6	86.5	88.5	76.7	251.7	3,323.6
No. 53	3	237.6	600.9	509.3	1,347.8	347.5	612.2	413.9	1,373.6	126.8	136.4	104.7	367.9	97.0	101.4	87.1	285.5	3,374.8
Average per day	......	244.5	542.0	493.1	1,279.6	314.2	566.6	455.2	1,336.0	128.8	137.1	109.8	375.7	97.7	100.4	88.5	286.6	3,277.9
Average Nos. 37, 40, 44, 47	......	264.5	537.2	493.2	1,294.9	331.5	551.3	461.7	1,344.5	124.5	118.4	87.4	330.3	83.2	79.3	76.9	239.4	3,209.1
Average Nos. 49, 53	......	249.6	503.0	449.3	1,201.9	321.0	560.9	472.6	1,354.5	140.5	135.5	109.7	385.7	102.5	101.7	93.5	297.7	3,239.8
Average Nos. 37, 40, 44, 47, 49, 53	......	260.5	527.8	481.2	1,269.5	328.6	553.9	464.7	1,347.2	128.8	123.1	93.5	345.4	88.5	85.4	81.4	255.3	3,217.4
Work experiments, fat diet.																		
No. 38	1	163.7	352.1	356.4	872.2	228.7	426.6	339.7	995.0	107.1	95.8	59.6	262.5	66.0	57.2	53.7	176.9	2,306.6
No. 38	2	198.9	423.2	387.9	1,010.0	273.6	391.3	398.8	1,063.7	121.2	91.6	91.4	304.2	85.4	83.4	82.3	251.1	2,629.0
No. 38	3	191.6	380.7	378.2	950.5	249.6	425.0	368.3	1,042.9	117.3	98.6	82.6	298.5	81.1	73.0	73.5	227.6	2,519.5
No. 38	4	198.2	393.4	354.9	946.5	246.8	415.9	332.9	995.6	121.6	90.2	75.2	287.0	78.6	66.5	69.5	214.6	2,443.7
Average per day	......	188.1	387.4	369.3	944.8	249.7	414.7	359.9	1,024.3	116.8	94.1	77.2	288.1	77.8	70.0	69.7	217.5	2,474.7
No. 41	1	259.3	567.5	460.2	1,287.0	331.6	578.3	460.2	1,370.1	129.8	118.2	90.9	338.9	78.7	79.8	79.3	237.8	3,233.8
No. 41	2	255.8	528.7	497.7	1,282.2	301.9	549.2	468.7	1,319.8	121.5	105.7	78.5	305.7	78.3	71.8	76.6	226.7	3,134.4
No. 41	3	428.3	588.8	490.7	1,507.8	287.5	528.2	460.2	1,275.9	120.3	123.7	79.1	323.1	82.7	72.6	78.2	233.5	3,340.3
No. 41	4	322.5	647.0	644.3	1,613.8	334.9	543.5	410.2	1,288.6	134.4	111.8	83.5	329.7	84.3	81.9	78.1	244.3	3,476.4
Average per day	......	316.5	583.0	523.2	1,422.7	314.0	549.8	449.8	1,313.6	126.5	114.8	83.0	324.3	81.0	76.5	78.1	235.6	3,296.2
No. 43	1	270.1	543.8	487.6	1,301.5	434.2	659.9	510.9	1,605.0	126.0	120.5	85.3	331.8	94.3	87.7	82.5	264.5	3,502.8
No. 43	2	287.1	625.9	528.5	1,441.5	337.9	496.1	316.0	1,150.0	122.6	132.0	86.2	340.8	84.8	83.1	96.2	264.1	3,196.4
No. 43	3	315.4	489.9	395.5	1,200.8	394.5	590.7	370.2	1,355.4	125.5	116.3	79.4	321.2	79.0	77.8	71.9	228.7	3,106.1
No. 43	4	264.1	530.4	386.7	1,181.2	312.4	468.6	444.1	1,225.1	115.7	117.2	93.0	325.9	92.2	81.6	89.3	254.1	2,986.3
Average per day	......	284.2	547.5	449.6	1,281.3	369.8	553.8	410.3	1,333.9	122.4	121.5	86.0	329.9	87.6	82.5	82.7	252.8	3,197.9
No. 45	1	253.6	540.3	524.9	1,318.8	331.3	542.1	395.1	1,268.5	128.9	117.1	78.0	324.0	91.0	79.2	79.2	249.4	3,160.7
No. 46	1	388.9	693.6	590.1	1,672.6	422.1	650.0	625.5	1,697.6	163.8	148.0	121.5	433.3	110.5	106.5	106.0	323.0	4,126.5
No. 46	2	351.1	600.7	583.4	1,535.2	418.3	616.5	504.2	1,539.0	151.8	138.0	117.5	407.3	117.7	114.0	103.6	335.3	3,816.8
No. 46	3	358.9	617.3	564.4	1,540.6	388.9	635.7	497.1	1,521.7	147.5	127.3	114.5	389.3	112.6	98.8	92.6	304.0	3,755.6
No. 46	4	301.8	575.6	542.4	1,419.8	374.2	612.7	473.1	1,460.0	151.5	122.7	116.3	390.5	107.6	103.3	99.7	310.6	3,580.9
Average per day	......	350.2	621.8	570.1	1,542.1	400.9	628.7	525.0	1,551.6	153.7	134.0	117.4	405.1	112.1	105.6	100.5	318.2	3,820.0

TABLE 121.—*Water eliminated from lungs and skin by 2-hour periods, metabolism experiments Nos. 35–55, inclusive*—Continued.

Kind and number of experiment.	Day.	7 a.m. to 9 a.m.	9 a.m. to 11 a.m.	11 a.m. to 1 p.m.	Total, 6 hours.	1 p.m. to 3 p.m.	3 p.m. to 5 p.m.	5 p.m. to 7 p.m.	Total, 6 hours.	7 p.m. to 9 p.m.	9 p.m. to 11 p.m.	11 p.m. to 1 a.m.	Total, 6 hours.	1 a.m. to 3 a.m.	3 a.m. to 5 a.m.	5 a.m. to 7 a.m.	Total, 6 hours.	Total, 1 day.
Work experiments, fat diet—Continued.		*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
No. 48	1	308.5	612.8	569.7	1,491.0	375.2	633.8	473.5	1,482.5	161.9	174.8	128.3	465.0	128.2	126.9	106.9	362.0	3,800.5
No. 52	1	247.5	478.4	511.2	1,237.1	435.8	703.7	568.6	1,708.1	172.2	128.8	123.7	424.7	109.5	102.3	105.8	317.6	3,687.5
No. 52	2	253.0	565.4	521.2	1,339.6	351.0	593.5	459.2	1,403.7	172.9	131.1	99.3	403.3	101.2	83.5	86.1	270.8	3,417.4
No. 52	3	292.1	546.3	503.1	1,341.5	342.6	619.5	490.0	1,452.1	152.5	134.3	120.6	407.4	109.4	110.8	111.5	331.7	3,532.7
Average per day	......	264.2	530.1	511.8	1,306.1	376.5	638.9	505.9	1,521.3	165.9	131.4	114.5	411.8	106.7	98.9	101.1	306.7	3,545.9
No. 54	1	242.5	529.9	475.0	1,247.4	288.8	579.4	488.6	1,356.8	125.0	138.4	113.3	376.7	119.4	102.4	94.9	316.7	3,297.6
No. 54	2	307.0	624.3	520.5	1,451.8	326.4	652.1	354.7	1,333.2	131.8	125.5	102.4	359.7	102.4	101.5	89.6	293.5	3,438.2
No. 54	3	292.4	618.7	569.1	1,480.2	341.4	488.0	450.1	1,279.5	151.2	157.9	97.0	406.1	102.2	99.5	82.6	284.3	3,450.1
Average per day	......	280.6	591.0	521.5	1,393.1	318.9	573.2	431.1	1,323.2	136.0	140.6	104.2	380.8	108.0	101.2	89.0	298.2	3,395.3
Average Nos. 38, 41, 43, 45, 46, 48	......	284.3	539.5	485.8	1,309.6	335.8	542.4	436.0	1,314.2	131.6	119.4	92.3	343.3	91.8	85.9	83.9	261.6	3,228.7
Average Nos. 52, 54	......	272.4	560.5	516.7	1,349.6	347.7	606.0	468.5	1,422.2	150.9	136.0	109.4	396.3	107.3	100.0	95.1	302.4	3,470.5
Average Nos. 38, 41, 43, 45, 46, 48, 52, 54	......	281.3	544.8	493.5	1,319.6	338.7	558.3	444.2	1,341.2	136.4	123.6	96.5	356.5	95.7	89.4	86.7	271.8	3,289.1

The following table shows the daily income and outgo of water in metabolism experiments Nos. 35–55.

TABLE 122.—*Daily income and outgo of water, metabolism experiments Nos. 35–55.*

Number, subject, and kind of experiment.	Days covered by experiments.	Income.			Outgo.			
		In food.	In drink.	Total.	In feces.	In urine.	In respiration and perspiration.	Total.
No. 35, J. C. W., rest:		*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
First day	....	922	1,000	1,922	78	1,452	954	2,484
Second day	....	922	1,000	1,922	78	1,184	870	2,132
Third day	....	922	1,000	1,922	78	1,446	863	2,387
Fourth day	....	922	1,000	1,922	78	1,374	837	2,289
Total	4	3,688	4,000	7,688	312	5,456	3,524	9,292
No. 36, J. C. W., rest, fasting	1	....	1,000	1,000	....	1,357	768	2,125
No. 37, J. C. W., work:								
First day	....	702	1,900	2,602	79	1,310	2,512	3,901
Second day	....	702	1,950	2,652	79	829	3,024	3,932
Third day	....	702	2,100	2,802	79	758	2,843	3,680
Fourth day	....	702	2,250	2,952	79	841	2,311	3,231
Total	4	2,808	8,200	11,008	316	3,738	10,690	14,744
No. 38, J. C. W., work:								
First day	....	1,334	1,500	2,834	90	883	2,307	3,280
Second day	....	1,334	1,500	2,834	90	963	2,629	3,682
Third day	....	1,334	1,500	2,834	90	947	2,519	3,556
Fourth day	....	1,334	1,500	2,834	90	946	2,444	3,480
Total	4	5,336	6,000	11,336	360	3,739	9,899	13,998
No. 39, J. C. W., rest, fasting	1	....	1,950	1,950	....	1,249	822	2,071
No. 40, J. C. W., work:								
First day	....	720	2,550	3,270	120	834	3,279	4,233
Second day	....	677	2,550	3,227	120	711	3,088	3,919
Third day	....	677	2,800	3,477	120	787	3,042	3,949
Fourth day	....	677	2,800	3,477	120	757	3,068	3,945
Total	4	2,751	10,700	13,451	480	3,089	12,477	16,046
No. 41, J. C. W., work:								
First day	....	1,444	2,800	4,244	135	1,130	3,234	4,499
Second day	....	1,444	2,800	4,244	135	1,682	3,134	4,951
Third day	....	1,444	2,800	4,244	135	1,658	3,340	5,133
Fourth day	....	1,444	2,800	4,244	135	1,481	3,476	5,092
Total	4	5,776	11,200	16,976	540	5,951	13,184	19,675
No. 42, J. C. W., rest, fasting	1	....	1,400	1,400	....	1,687	842	2,529
No. 43, J. C. W., work:								
First day	....	2,543	2,150	4,693	182	1,619	3,503	5,304
Second day	....	2,543	2,150	4,693	182	1,852	3,196	5,230
Third day	....	2,543	2,150	4,693	182	1,938	3,106	5,226
Fourth day	....	2,543	2,150	4,693	182	2,199	2,986	5,367
Total	4	10,172	8,600	18,772	728	7,608	12,791	21,127
No. 44, J. C. W., work:								
First day	....	1,861	2,950	4,811	164	1,925	3,173	5,262
Second day	....	1,861	2,950	4,811	164	2,019	3,035	5,218
Third day	....	1,861	2,950	4,811	164	2,193	3,098	5,455
Fourth day	....	1,861	2,950	4,811	164	1,847	3,575	5,586
Total	4	7,444	11,800	19,244	656	7,984	12,881	21,521
No. 45, J. C. W., work	1	2,537	2,150	4,687	215	2,162	3,161	5,538

TABLE 122.—*Daily income and outgo of water, etc.*—Continued.

Number, subject, and kind of experiment.	Days covered by experiments.	Income. In food.	Income. In drink.	Income. Total.	Outgo. In feces.	Outgo. In urine.	Outgo. In respiration and perspiration.	Outgo. Total.
No. 46, J. C. W., work:		*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
First day	....	2,586	2,150	4,736	181	1,285	4,126	5,592
Second day	....	2,586	2,150	4,736	181	1,182	3,817	5,180
Third day	....	2,586	2,150	4,736	181	1,183	3,756	5,120
Fourth day	....	2,586	2,150	4,736	181	1,542	3,581	5,304
Total	4	10,344	8,600	18,944	724	5,192	15,280	21,196
No. 47, J. C. W., work:								
First day	....	1,904	2,950	4,854	185	1,574	3,783	5,542
Second day	....	1,904	2,950	4,854	185	1,522	3,720	5,427
Third day	....	1,904	2,950	4,854	185	1,671	3,771	5,627
Fourth day	....	1,904	2,950	4,854	185	1,396	4,024	5,605
Total	4	7,616	11,800	19,416	740	6,163	15,298	22,201
No. 48, J. C. W., work	1	2,581	2,150	4,731	193	1,349	3,800	5,342
No. 49, J. C. W., work:								
First day	....	2,292	2,800	5,092	170	1,954	3,514	5,638
Second day	....	2,292	2,800	5,092	170	2,204	3,060	5,434
Third day	....	2,292	2,800	5,092	170	2,648	3,031	5,849
Total	3	6,876	8,400	15,276	510	6,806	9,605	16,921
No. 50, J. C. W., work [a]	1	1,579	1,300	2,879	92	1,626	2,232	3,950
No. 51, J. C. W., rest, fasting:								
First day	....	....	750	750	....	971	1,018	1,989
Second day	....	565	250	815	....	728	895	1,623
Total	2	565	1,000	1,565	....	1,699	1,913	3,612
No. 52, J. C. W., work:								
First day	....	2,917	1,950	4,867	197	2,061	3,688	5,946
Second day	....	2,903	1,950	4,853	197	1,344	3,417	4,958
Third day	....	2,903	1,950	4,853	197	1,817	3,532	5,546
Total	3	8,723	5,850	14,573	591	5,222	10,637	16,450
No. 53, J. C. W., work:								
First day	....	2,300	1,950	4,250	212	944	3,135	4,291
Second day	....	2,300	1,950	4,250	212	1,114	3,324	4,650
Third day	....	2,300	1,950	4,250	212	1,388	3,375	4,975
Total	3	6,900	5,850	12,750	636	3,446	9,834	13,916
No. 54, J. C. W., work:								
First day	....	2,867	1,950	4,817	167	2,329	3,298	5,794
Second day	....	2,802	1,950	4,752	167	1,936	3,438	5,541
Third day	....	2,819	1,950	4,769	167	1,984	3,450	5,601
Total	3	8,488	5,850	14,338	501	6,249	10,186	16,936
No. 55, J. C. W., work (extra severe)	1	3,090	2,850	5,940	167	1,103	7,381	8,651

[a] $5\frac{1}{2}$ hours' work on insufficient diet.

Table 123 summarizes the results of the calorimetric measurements by 2-hour periods in experiments Nos. 35–55, inclusive.

TABLE 123.—*Summary of calorimetric measurements, metabolism experiments Nos. 35–55, inclusive.*

Date.	Period.	(a) Heat measured in terms of C_{20}.	(b) Change of temperature of calorimeter.	(c) Capacity correction of calorimeter, $b \times 60$.	(d) Correction due to temperature of food and dishes.	(e) Water vaporized, equals total excess in outgoing air plus excess residual vapor.	(f) Heat rendered latent in vaporization of water, $e \times 0.592$.	(g) Total heat determined, $a+c+d+f$.
1900.	*Preliminary to experiment No 35.*	*Calories.*	*Degrees.*	*Cals.*	*Cals.*	*Grams.*	*Calories.*	*Calories.*
Dec. 8–9	7 p. m. to 9 p. m.	188.2	−0.08	− 4.8	+ 4.7	90.2	53.4	241.5
	9 p. m. to 11 p. m.	181.6	− .02	− 1.2	+ 1.6	92.8	54.9	236.9
	11 p. m. to 1 a. m.	121.9	+ .08	+ 4.8	....	86.5	51.2	177.9
	Total, 6 hours	491.7	− .02	− 1.2	+ 6.3	269.5	159.5	656.3
	1 a. m. to 3 a. m.	118.8	− .02	− 1.2	+ 4.6	89.9	53.2	175.4
	3 a. m. to 5 a. m.	124.5	− .03	− 1.8	....	87.8	52.0	174.7
	5 a. m. to 7 a. m.	104.2	+ .12	+ 7.2	+ 2.0	75.0	44.4	157.8
	Total, 6 hours	347.5	+ .07	+ 4.2	+ 6.6	252.7	149.6	507.9
	Total, ½ day	839.2	+ .05	+ 3.0	+12.9	522.2	309.1	1,164.2
	Experiment No. 35.							
9–10	7 a. m. to 9 a. m.	215.2	− .11	− 6.6	....	99.3	58.8	267.4
	9 a. m. to 11 a. m.	192.8	+ .02	+ 1.2	+ 2.1	86.9	51.4	247.5
	11 a. m. to 1 p. m.	169.4	+ .01	+ .6	....	81.5	48.2	218.2
	Total, 6 hours	577.4	− .08	− 4.8	+ 2.1	267.7	158.4	733.1
	1 p. m. to 3 p. m.	185.0	− .01	− .6	....	85.4	50.6	235.0
	3 p. m. to 5 p. m.	179.7	....	....	....	83.9	49.7	229.4
	5 p. m. to 7 p. m.	168.4	− .06	− 3.6	....	86.1	51.0	215.8
	Total, 6 hours	533.1	− .07	− 4.2	....	255.4	151.3	680.2
	7 p. m. to 9 p. m.	185.2	+ .03	+ 1.8	....	80.0	47.4	234.4
	9 p. m. to 11 p. m.	175.7	− .04	− 2.4	....	83.7	49.5	222.8
	11 p. m. to 1 a. m.	95.6	....	....	....	70.9	42.0	137.6
	Total, 6 hours	456.5	− .01	− .6	....	234.6	138.9	594.8
	1 a. m. to 3 a. m.	100.6	....	....	....	74.7	44.2	144.8
	3 a. m. to 5 a. m.	92.9	....	....	....	50.8	30.1	123.0
	5 a. m. to 7 a. m.	97.1	− .02	− 1.2	....	71.1	42.1	138.0
	Total, 6 hours	290.6	− .02	− 1.2	....	196.6	116.4	405.8
	Total, 1 day	1,857.6	− .18	−10.8	+ 2.1	954.3	565.0	2,413.9
10–11	7 a. m. to 9 a. m.	197.1	+ .03	+ 1.8	+ 4.2	85.1	50.4	253.5
	9 a. m. to 11 a. m.	181.8	....	....	+ 1.9	70.4	41.7	225.4
	11 a. m. to 1 p. m.	163.9	− .01	− .6	....	75.2	44.5	207.8
	Total, 6 hours	542.8	+ .02	+ 1.2	+ 6.1	230.7	136.6	686.7
	1 p. m. to 3 p. m.	188.7	− .02	− 1.2	+ 4.4	74.9	44.3	236.2
	3 p. m. to 5 p. m.	180.2	− .02	− 1.2	+ 2.0	73.6	43.6	224.6
	5 p. m. to 7 p. m.	160.2	+ .01	+ .6	+ 2.7	78.0	46.2	209.7
	Total, 6 hours	529.1	− .03	− 1.8	+ 9.1	226.5	134.1	670.5

TABLE 123.—*Summary of calorimetric measurements, etc.*—Continued.

Date.	Period.	(*a*) Heat measured in terms of C_{20}.	(*b*) Change of temperature of calorimeter.	(*c*) Capacity correction of calorimeter, $b \times 60$.	(*d*) Correction due to temperature of food and dishes.	(*e*) Water vaporized, equals total excess in outgoing air plus excess residual vapor.	(*f*) Heat rendered latent in vaporization of water, $e \times 0.592$.	(*g*) Total heat determined, $a+c+d+f$.
	Experiment No. 35—Continued.							
1900.		*Calories.*	*Degrees.*	*Cals.*	*Cals.*	*Grams.*	*Calories.*	*Calories.*
Dec. 10–11	7 p. m. to 9 p. m.	169.6	−0.03	− 1.8	....	68.0	40.3	208.1
	9 p. m. to 11 p. m.	153.1	+ .04	+ 2.4	+ 2.8	71.1	42.1	200.4
	11 p. m. to 1 a. m.	109.3	+ .06	+ 3.6	....	73.4	43.5	156.4
	Total, 6 hours	432.0	+ .07	+ 4.2	+ 2.8	212.5	125.9	564.9
	1 a. m. to 3 a. m.	134.0	− .02	− 1.2	....	66.1	39.1	171.9
	3 a. m. to 5 a. m.	102.4	− .01	− .6	....	66.1	39.1	140.9
	5 a. m. to 7 a. m.	112.4	− .02	− 1.2	....	67.9	40.2	151.4
	Total, 6 hours	348.8	− .05	− 3.0	....	200.1	118.4	464.2
	Total, 1 day	1,852.7	+ .01	+ .6	+18.0	869.8	515.0	2,386.3
11–12	7 a. m. to 9 a. m.	196.0	− .03	− 1.8	+ 2.4	83.1	49.2	245.8
	9 a. m. to 11 a. m.	183.3	+ .02	+ 1.2	+ 2.5	71.9	42.6	229.6
	11 a. m. to 1 p. m.	161.2	....	....	....	62.8	37.2	198.4
	Total, 6 hours	540.5	− .01	− .6	+ 4.9	217.8	129.0	673.8
	1 p. m. to 3 p. m.	180.6	+ .01	+ .6	+ 5.2	70.7	41.8	228.2
	3 p. m. to 5 p. m.	177.8	....	....	+ 1.7	68.7	40.7	220.2
	5 p. m. to 7 p. m.	178.2	....	....	+ 1.7	80.8	47.8	227.7
	Total, 6 hours	536.6	+ .01	+ .6	+ 8.6	220.2	130.3	676.1
	7 p. m. to 9 p. m.	188.0	− .01	− .6	....	74.2	43.9	231.3
	9 p. m. to 11 p. m.	179.0	+ .07	+ 4.2	+ 2.7	71.4	42.3	228.2
	11 p. m. to 1 a. m.	117.0	− .04	− 2.4	....	67.9	40.2	154.8
	Total, 6 hours	484.0	+ .02	+ 1.2	+ 2.7	213.5	126.4	614.3
	1 a. m. to 3 a. m.	102.5	− .03	− 1.8	....	69.7	41.3	142.0
	3 a. m. to 5 a. m.	102.0	− .01	− .6	....	70.6	41.8	143.2
	5 a. m. to 7 a. m.	113.0	+ .14	+ 8.4	....	71.1	42.1	163.5
	Total, 6 hours	317.5	+ .10	+ 6.0	....	211.4	125.2	448.7
	Total, 1 day	1,878.6	+ .12	+ 7.2	+16.2	862.9	510.9	2,412.9
12–13	7 a. m. to 9 a. m.	206.1	− .12	− 7.2	+ 3.9	74.3	44.0	246.8
	9 a. m. to 11 a. m.	185.3	+ .01	+ .6	+ 2.6	68.7	40.7	229.2
	11 a. m. to 1 p. m.	177.4	− .03	− 1.8	....	69.5	41.1	216.7
	Total, 6 hours	568.8	− .14	− 8.4	+ 6.5	212.5	125.8	692.7
	1 p. m. to 3 p. m.	179.7	....	....	+ 3.3	72.2	42.7	225.7
	3 p. m. to 5 p. m.	178.8	+ .03	+ 1.8	+ 1.5	72.6	43.0	225.1
	5 p. m. to 7 p. m.	168.9	− .01	− .6	+ 3.0	72.3	42.8	214.1
	Total, 6 hours	527.4	+ .02	+ 1.2	+ 7.8	217.1	128.5	664.9
	7 p. m. to 9 p. m.	167.4	....	....	....	63.9	37.8	205.2
	9 p. m. to 11 p. m.	156.9	− .01	− .6	+ 2.8	70.5	41.7	200.8
	11 p. m. to 1 a. m.	93.3	− .06	− 3.6	....	71.2	42.2	131.9
	Total, 6 hours	417.6	− .07	− 4.2	+ 2.8	205.6	121.7	537.9

TABLE 123.—*Summary of calorimetric measurements, etc.*—Continued.

Date.	Period.	(a) Heat measured in terms of C_{20}.	(b) Change of temperature of calorimeter.	(c) Capacity correction of calorimeter, $b\times60$.	(d) Correction due to temperature of food and dishes.	(e) Water vaporized, equals total excess in outgoing air plus excess residual vapor.	(f) Heat rendered latent in vaporization of water, $e\times0.592$.	(g) Total heat determined, $a+c+d+f$.
1900.	*Experiment No. 35*—Continued.	*Calories.*	*Degrees.*	*Cals.*	*Cals.*	*Grams.*	*Calories.*	*Calories.*
Dec. 12–13.....	1 a. m. to 3 a. m ...	118.1	+0.06	+3.6	....	65.9	39.0	160.7
	3 a. m. to 5 a. m ...	116.1	− .02	−1.2	....	67.3	39.8	154.7
	5 a. m. to 7 a. m ...	120.9	+ .04	+2.4	....	68.6	40.6	163.9
	Total, 6 hours	355.1	+ .08	+4.8	....	201.8	119.4	479.3
	Total, 1 day..	1,868.9	− .11	−6.6	+17.1	837.0	495.4	2,374.8
	Total, 4 days.	7,457.8	− .16	−9.6	+53.4	3,524.0	2,086.3	9,587.9
	Experiment No. 36.							
13–14.....	7 a. m. to 9 a.m....	192.0	....	....	+ 2.1	73.3	43.4	237.5
	9 a. m. to 11 a. m ..	179.0	− .01	− .6	+ 2.0	61.6	36.5	216.9
	11 a.m. to 1 p. m...	163.8	+ .01	+ .6	+ 2.8	59.6	35.3	202.5
	Total, 6 hours	534.8	....	....	+ 6.9	194.5	115.2	656.9
	1 p. m. to 3 p. m...	170.8	+ .03	+1.8	+ 2.0	64.4	38.1	212.7
	3 p. m. to 5 p. m...	166.0	− .03	−1.8	....	59.3	35.1	199.3
	5 p. m. to 7 p. m...	158.2	+ .02	+1.2	+ 2.4	62.6	37.1	198.9
	Total, 6 hours	495.0	+ .02	+1.2	+ 4.4	186.3	110.3	610.9
	7 p. m. to 9 p. m...	161.4	+ .01	+ .6	+ 2.4	64.0	37.9	202.3
	9 p. m. to 11 p. m..	155.0	+ .03	+1.8	....	61.3	36.3	193.1
	11 p. m. to 1 a. m ..	91.6	+ .01	+ .6	....	66.4	39.3	131.5
	Total, 6 hours	408.0	+ .05	+3.0	+ 2.4	191.7	113.5	526.9
	1 a. m. to 3 a. m ...	97.2	− .06	−3.6	....	64.2	38.0	131.6
	3 a. m. to 5 a. m ...	108.4	+ .03	+1.8	....	66.0	39.1	149.3
	5 a. m. to 7 a. m ...	136.7	+ .03	+1.8	....	65.4	38.7	177.2
	Total, 6 hours	342.3	....	....	....	195.6	115.8	458.1
	Total, 1 day .	1,780.1	+ .07	+4.2	+13.7	768.1	454.8	2,252.8
1901.	*Preliminary to experiment No. 37.*							
Jan. 10–11.....	7 p. m. to 9 p. m...	210.5	....	....	....	88.8	52.6	263.1
	9 p. m. to 11 p. m..	205.0	....	....	....	82.2	48.7	253.7
	11 p. m. to 1 a. m ..	86.2	+ .02	+1.2	....	74.9	44.3	131.7
	Total, 6 hours	501.7	+ .02	+1.2	....	245.9	145.6	648.5
	1 a. m. to 3 a. m ...	117.3	− .02	−1.2	....	84.2	49.8	165.9
	3 a. m. to 5 a. m ...	105.4	− .04	−2.4	....	80.7	47.8	150.8
	5 a. m. to 7 a. m ...	112.9	− .07	−4.2	....	80.8	48.4	157.1
	Total, 6 hours	335.6	− .13	−7.8	....	245.7	146.0	473.8
	Total, ½ day..	837.3	− .11	−6.6	....	491.6	291.6	1,122.3
	Experiment No. 37.							
11–12.....	7 a. m. to 9 a. m ...	385.2	+ .11	+6.6	+ 8.2	107.2	63.5	463.5
	9 a. m. to 11 a. m ..	563.4	+ .04	+2.4	+ 3.0	103.6	61.3	630.1
	11 a. m. to 1 p. m ..	484.9	− .06	−3.6	....	104.5	61.9	543.2
	Total, 6 hours	1,433.5	+ .09	+5.4	+11.2	315.3	186.7	1,636.8

TABLE 123.—*Summary of calorimetric measurements, etc.*—Continued.

Date.	Period.	(*a*) Heat measured in terms of C_{20}.	(*b*) Change of temperature of calorimeter.	(*c*) Capacity correction of calorimeter, $b \times 60$.	(*d*) Correction due to temperature of food and dishes.	(*e*) Water vaporized, equals total excess in outgoing air plus excess residual vapor.	(*f*) Heat rendered latent in vaporization of water, $e \times 0.592$.	(*g*) Total heat determined, $a+c+d+f$.
1901.	*Experiment No. 37*—Continued.	*Calories.*	*Degrees.*	*Cals.*	*Cals.*	*Grams.*	*Calories.*	*Calories.*
Jan. 11–12	1 p. m. to 3 p. m	364.4	+0.25	+15.0	+ 5.5	97.2	57.5	442.4
	3 p. m. to 5 p. m	614.1	− .08	− 4.8	+ 3.5	109.8	65.0	677.8
	5 p. m. to 7 p. m	560.3	− .12	− 7.2	+ 5.0	110.0	65.1	623.2
	Total, 6 hours	1,538.8	+ .05	+ 3.0	+14.0	317.0	187.6	1,743.4
	7 p. m. to 9 p. m	236.7	+ .13	+ 7.8	....	90.6	53.6	298.1
	9 p. m. to 11 p. m	232.9	− .09	− 5.4	+ 3.3	99.8	59.1	289.9
	11 p. m. to 1 a. m	96.4	− .07	− 4.2	....	103.8	61.5	153.7
	Total, 6 hours	566.0	− .03	− 1.8	+ 3.3	294.2	174.2	741.7
	1 a. m. to 3 a. m	111.8	− .01	− .6	....	107.5	63.6	174.8
	3 a. m. to 5 a. m	99.7	− .03	− 1.8	....	97.3	57.6	155.5
	5 a. m. to 7 a. m	108.8	+ .13	+ 7.8	....	98.4	58.3	174.9
	Total, 6 hours	320.3	+ .09	+ 5.4	....	303.2	179.5	505.2
	Total, 1 day	3,858.6	+ .20	+12.0	+28.5	1,229.7	728.0	4,627.1
12–13	7 a. m. to 9 a. m	417.0	− .23	−13.8	+ 7.9	109.5	64.8	475.9
	9 a. m. to 11 a. m	665.5	+ .04	+ 2.4	+ 3.5	110.0	65.1	736.5
	11 a. m. to 1 p. m	655.7	+ .05	+ 3.0	....	118.3	70.0	728.7
	Total, 6 hours	1,738.2	− .14	− 8.4	+11.4	337.8	199.9	1,941.1
	1 p. m. to 3 p. m	487.9	+ .07	+ 4.2	+ 5.0	105.2	62.3	559.4
	3 p. m. to 5 p. m	708.3	− .07	− 4.2	+ 2.9	112.0	66.3	773.3
	5 p. m. to 7 p. m	538.5	+ .18	+10.8	+ 5.4	112.8	66.8	621.5
	Total, 6 hours	1,734.7	+ .18	+10.8	+13.3	330.0	195.4	1,954.2
	7 p. m. to 9 p. m	239.0	− .12	− 7.2	....	100.9	59.7	291.5
	9 p. m. to 11 p. m	213.3	− .01	− .6	+ 3.0	100.0	59.2	274.9
	11 p. m. to 1 a. m	82.4	− .12	− 7.2	....	100.2	59.3	134.5
	Total, 6 hours	534.7	− .25	−15.0	+ 3.0	301.1	178.2	700.9
	1 a. m. to 3 a. m	114.0	− .09	− 5.4	....	100.2	59.3	167.9
	3 a. m. to 5 a. m	71.6	− .06	− 3.6	....	93.3	55.2	123.2
	5 a. m. to 7 a. m	89.2	....	....	....	98.9	58.6	147.8
	Total, 6 hours	274.8	− .15	− 9.0	....	292.4	173.1	438.9
	Total, 1 day	4,282.4	− .36	−21.6	+27.7	1,261.3	746.6	5,035.1
13–14	7 a. m. to 9 a. m	436.8	− .07	− 4.2	+ 8.4	105.3	62.3	503.3
	9 a. m. to 11 a. m	690.3	+ .03	+ 1.8	+ 3.1	96.0	56.8	752.0
	11 a. m. to 1 p. m	624.9	− .05	− 3.0	....	122.7	72.6	694.5
	Total, 6 hours	1,752.0	− .09	− 5.4	+11.5	324.0	191.7	1,949.8
	1 p. m. to 3 p. m	406.1	+ .28	+16.8	+ 6.5	103.6	61.3	490.7
	3 p. m. to 5 p. m	719.5	− .01	− .6	+ 5.0	109.2	64.6	788.5
	5 p. m. to 7 p. m	493.2	+ .12	+ 7.2	+ 5.7	117.3	69.4	575.5
	Total, 6 hours	1,618.8	+ .39	+23.4	+17.2	330.1	195.3	1,854.7

TABLE 123.—*Summary of calorimetric measurements, etc.*—Continued.

Date.	Period.	(*a*) Heat measured in terms of C_{20}.	(*b*) Change of temperature of calorimeter.	(*c*) Capacity correction of calorimeter, $b \times 60$.	(*d*) Correction due to temperature of food and dishes.	(*e*) Water vaporized, equals total excess in outgoing air plus excess residual vapor.	(*f*) Heat rendered latent in vaporization of water, $e \times 0.592$.	(*g*) Total heat determined, $a+c+d+f$.
	Experiment No. 37—Continued.							
1901.		*Calories.*	*Degrees.*	*Cals.*	*Cals.*	*Grams.*	*Calories.*	*Calories.*
Jan. 13–14	7 p. m. to 9 p. m	211.9	−0.21	−12.6	....	102.4	60.6	259.9
	9 p. m. to 11 p. m	198.1	− .03	− 1.8	+ 3.5	106.1	62.8	262.6
	11 p. m. to 1 a. m	78.2	− .02	− 1.2	....	104.1	61.6	138.6
	Total, 6 hours	488.2	− .26	−15.6	+ 3.5	312.6	185.0	661.1
	1 a. m. to 3 a. m	96.0	+ .07	+ 4.2	....	104.5	61.8	162.0
	3 a. m. to 5 a. m	106.6	− .04	− 2.4	....	93.2	55.2	159.4
	5 a. m. to 7 a. m	100.5	− .11	− 6.6	....	94.6	56.0	149.9
	Total, 6 hours	303.1	− .08	− 4.8	....	292.3	173.0	471.3
	Total, 1 day	4,162.1	− .04	− 2.4	+ 32.2	1,259.0	745.0	4,936.9
14–15	7 a. m. to 9 a. m	361.8	+ .14	+ 8.4	+ 8.0	100.9	59.7	437.9
	9 a. m. to 11 a. m	609.1	+ .01	+ .6	+ 5.5	104.0	61.6	676.8
	11 a. m. to 1 p. m	526.0	− .05	− 3.0	....	100.0	59.2	582.2
	Total, 6 hours	1,496.9	+ .10	+ 6.0	+ 13.5	304.9	180.5	1,696.9
	1 p. m. to 3 p. m	417.7	+ .14	+ 8.4	+ 5.5	97.4	57.7	489.3
	3 p. m. to 5 p. m	589.3	− .02	− 1.2	+ 5.7	113.0	66.9	660.7
	5 p. m. to 7 p. m	473.6	− .03	− 1.8	+ 5.2	100.0	59.2	536.2
	Total, 6 hours	1,480.6	+ .09	+ 5.4	+ 16.4	310.4	183.8	1,686.2
	7 p. m. to 9 p. m	209.9	− .13	− 7.8	....	94.5	55.9	258.0
	9 p. m. to 11 p. m	188.0	+ .04	+ 2.4	+ 3.3	95.1	56.3	250.0
	11 p. m. to 1 a. m	72.9	+ .06	+ 3.6	....	105.6	62.5	139.0
	Total, 6 hours	470.8	− .03	− 1.8	+ 3.3	295.2	174.7	647.0
	1 a. m. to 3 a. m	92.5	− .01	− .6	....	94.3	55.8	147.7
	3 a. m. to 5 a. m	88.0	− .09	− 5.4	....	92.1	54.5	137.1
	5 a. m. to 7 a. m	82.9	+ .03	+ 1.8	....	97.8	57.9	142.6
	Total, 6 hours	263.4	− .07	− 4.2	....	284.2	168.2	427.4
	Total, 1 day	3,711.7	+ .09	+ 5.4	+ 33.2	1,194.7	707.2	4,457.5
	Total, 4 days	16,014.8	− .11	− 6.6	+121.6	4,944.7	2,926.8	19,056.6
	Experiment No. 38.							
15–16	7 a. m. to 9 a. m	345.5	+ .08	+ 4.8	+ 8.2	95.7	56.7	415.2
	9 a. m. to 11 a. m	590.0	− .01	− .6	+ 3.2	100.1	59.3	651.9
	11 a. m. to 1 p. m	541.4	− .01	− .6	....	100.4	59.4	600.2
	Total, 6 hours	1,476.9	+ .06	+ 3.6	+ 11.4	296.2	175.4	1,667.3
	1 p. m. to 3 p. m	428.8	+ .08	+ 4.8	+ .3	96.7	57.2	491.1
	3 p. m. to 5 p. m	608.5	− .05	− 3.0	+ 3.5	110.6	65.5	674.5
	5 p. m. to 7 p. m	498.8	− .06	− 3.6	+ 3.7	105.7	62.6	561.5
	Total, 6 hours	1,536.1	− .03	− 1.8	+ 7.5	313.0	185.3	1,727.1
	7 p. m. to 9 p. m	207.8	+ .02	+ 1.2	....	93.1	55.1	264.1
	9 p. m. to 11 p. m	194.3	....	....	+ 2.8	95.8	56.7	253.8
	11 p. m. to 1 a. m	80.7	....	....	....	101.6	60.1	140.8
	Total, 6 hours	482.8	+ .02	+ 1.2	+ 2.8	290.5	171.9	658.7

TABLE 123.—*Summary of calorimetric measurements, etc.*—Continued.

Date.	Period.	(*a*) Heat measured in terms of C_{20}.	(*b*) Change of temperature of calorimeter.	(*c*) Capacity correction of calorimeter, $b \times 60$.	(*d*) Correction due to temperature of food and dishes.	(*e*) Water vaporized, equals total excess in outgoing air plus excess residual vapor.	(*f*) Heat rendered latent in vaporization of water, $e \times 0.592$.	(*g*) Total heat determined, $a+c+d+f$.
	Experiment No. 38—Continued.							
1901.		*Calories.*	*Degrees.*	*Cals.*	*Cals.*	*Grams.*	*Calories.*	*Calories.*
Jan. 15-16	1 a. m. to 3 a. m	93.1	+0.07	+4.2	....	108.0	63.9	161.2
	3 a. m. to 5 a. m	83.8	− .02	−1.2	....	99.2	58.7	141.3
	5 a. m. to 7 a. m	106.7	− .04	−2.4	....	94.7	56.1	160.4
	Total, 6 hours	283.6	+ .01	+ .6	....	301.9	178.7	462.9
	Total, 1 day	3,779.4	+ .06	+3.6	+21.7	1,201.6	711.3	4,516.0
16-17	7 a. m. to 9 a. m	367.3	− .02	−1.2	+ 7.8	101.9	60.3	434.2
	9 a. m. to 11 a. m	614.5	+ .10	+6.0	+ 4.2	106.2	62.9	687.6
	11 a. m. to 1 p. m	543.9	− .09	−5.4	....	95.9	56.8	595.3
	Total, 6 hours	1,525.7	− .01	− .6	+12.0	304.0	180.0	1,717.1
	1 p. m. to 3 p. m	426.1	+ .06	+3.6	+ 3.2	111.6	66.1	499.0
	3 p. m. to 5 p. m	618.8	+ .02	+1.2	....	108.3	64.1	684.1
	5 p. m. to 7 p. m	490.4	− .05	−3.0	+ 4.8	95.8	56.7	548.9
	Total, 6 hours	1,535.3	+ .03	+1.8	+ 8.0	315.7	186.9	1,732.0
	7 p. m. to 9 p. m	205.6	− .03	−1.8	....	93.2	55.2	259.0
	9 p. m. to 11 p. m	181.2	....	....	+ 3.4	98.6	58.4	243.0
	11 p. m. to 1 a. m	89.0	+ .09	+5.4	....	106.4	63.0	157.4
	Total, 6 hours	475.8	+ .06	+3.6	+ 3.4	298.2	176.6	659.4
	1 a. m. to 3 a. m	125.8	− .07	−4.2	....	100.4	59.4	181.0
	3 a. m. to 5 a. m	98.8	− .03	−1.8	....	98.4	58.3	155.3
	5 a. m. to 7 a. m	105.0	+ .01	+ .6	....	96.3	57.0	162.6
	Total, 6 hours	329.6	− .09	−5.4	....	295.1	174.7	498.9
	Total, 1 day	3,866.4	− .01	− .6	+23.4	1,213.0	718.2	4,607.4
17-18	7 a. m. to 9 a. m	373.6	− .02	−1.2	+ 6.8	106.6	63.1	442.3
	9 a. m. to 11 a. m	567.9	+ .05	+3.0	+ 2.6	104.7	61.8	635.3
	11 a. m. to 1 p. m	520.1	− .04	−2.4	....	103.2	61.1	578.8
	Total, 6 hours	1,461.6	− .01	− .6	+ 9.4	314.5	186.0	1,656.4
	1 p. m. to 3 p. m	407.6	+ .03	+1.8	+ 2.9	107.6	63.7	476.0
	3 p. m. to 5 p. m	590.3	+ .10	+6.0	+ 3.8	106.0	62.8	662.9
	5 p. m. to 7 p. m	419.1	− .09	−5.4	+ 3.5	109.3	64.7	481.9
	Total, 6 hours	1,417.0	+ .04	+2.4	+10.2	322.9	191.2	1,620.8
	7 p. m. to 9 p. m	206.8	− .01	− .6	....	96.3	57.0	263.2
	9 p. m. to 11 p. m	192.2	− .01	− .6	+ 3.1	98.6	58.4	253.1
	11 p. m. to 1 a. m	96.6	....	....	....	107.6	63.7	160.3
	Total, 6 hours	495.6	− .02	−1.2	+ 3.1	302.5	179.1	676.6
	1 a. m. to 3 a. m	106.7	+ .01	+ .6	....	106.1	62.8	170.1
	3 a. m. to 5 a. m	89.1	+ .01	+ .6	....	98.0	58.0	147.7
	5 a. m. to 7 a. m	104.3	− .03	−1.8	....	97.5	57.7	160.2
	Total, 6 hours	300.1	− .01	− .6	....	301.6	178.5	478.0
	Total, 1 day	3,674.3	....	....	+22.7	1,241.5	734.8	4,431.8

TABLE 123.—*Summary of calorimetric measurements, etc.*—Continued.

Date.	Period.	(*a*) Heat measured in terms of C_{20}.	(*b*) Change of temperature of calorimeter.	(*c*) Capacity correction of calorimeter, $b\times60$.	(*d*) Correction due to temperature of food and dishes.	(*e*) Water vaporized, equals total excess in outgoing air plus excess residual vapor.	(*f*) Heat rendered latent in vaporization of water, $e\times0.592$.	(*g*) Total heat determined, $a+c+d+f$.
1901.	*Experiment No. 38*—Continued.	*Calories.*	*Degrees.*	*Cals.*	*Cals.*	*Grams.*	*Calories.*	*Calories.*
Jan. 18-19.....	7 a. m. to 9 a. m...	345.7	−0.05	− 3.0	+ 7.3	99.2	58.7	408.7
	9 a. m. to 11 a. m..	574.6	+ .05	+ 3.0	+ 3.9	117.4	69.5	651.0
	11 a. m. to 1 p. m..	497.1	+ .04	+ 2.4	....	108.9	64.5	564.0
	Total, 6 hours	1,417.4	+ .04	+ 2.4	+11.2	325.5	192.7	1,623.7
	1 p. m. to 3 p. m...	372.5	− .05	− 3.0	+ 3.8	98.8	58.5	431.8
	3 p. m. to 5 p. m...	584.4	+ .06	+ 3.6	+ 4.0	118.9	70.4	662.4
	5 p. m. to 7 p. m...	449.4	− .07	− 4.2	+ 4.2	111.9	66.2	515.6
	Total, 6 hours	1,406.3	− .06	− 3.6	+12.0	329.6	195.1	1,609.8
	7 p. m. to 9 p. m...	207.0	+ .08	+ 4.8	....	93.6	55.4	267.2
	9 p. m. to 11 p. m..	176.6	+ .05	+ 3.0	+ 2.7	97.2	57.5	239.8
	11 p. m. to 1 a. m..	86.1	....	....	....	102.2	60.5	146.6
	Total, 6 hours	469.7	+ .13	+ 7.8	+ 2.7	293.0	173.4	653.6
	1 a. m. to 3 a. m...	114.8	+ .03	+ 1.8	....	105.6	62.5	179.1
	3 a. m. to 5 a. m...	90.6	− .03	− 1.8	....	93.5	55.4	144.2
	5 a. m. to 7 a. m...	89.7	− .08	− 4.8	....	95.5	56.5	141.4
	Total, 6 hours	295.1	− .08	− 4.8	....	294.6	174.4	464.7
	Total, 1 day..	3,588.5	+ .03	+ 1.8	+25.9	1,242.7	735.6	4,351.8
	Total, 4 days.	14,908.6	+ .08	+ 4.8	+93.7	4,898.8	2,899.9	17,907.0
	Experiment No. 39.							
19-20.....	7 a. m. to 9 a. m...	161.3	+ .02	+ 1.2	+ 5.7	85.5	50.6	218.8
	9 a. m. to 11 a. m..	143.5	− .03	− 1.8	+ 3.8	90.5	53.6	199.1
	11 a. m. to 1 p. m..	120.7	− .06	− 3.6	....	78.0	46.2	163.3
	Total, 6 hours	425.5	− .07	− 4.2	+ 9.5	254.0	150.4	581.2
	1 p. m. to 3 p. m...	125.8	+ .06	+ 3.6	+ 6.1	86.7	51.3	186.8
	3 p. m. to 5 p. m...	107.1	....	....	+ 3.0	87.0	51.5	161.6
	5 p. m. to 7 p. m...	114.7	+ .02	+ 1.2	+ 5.4	80.6	47.7	169.0
	Total, 6 hours	347.6	+ .08	+ 4.8	+14.5	254.3	150.5	517.4
	7 p. m. to 9 p. m...	105.7	− .12	− 7.2	....	75.2	44.5	143.0
	9 p. m. to 11 p. m..	97.1	+ .17	+10.2	+ 3.2	83.1	49.2	159.7
	11 p. m. to 1 a. m..	109.7	+ .12	+ 7.2	....	80.8	47.8	164.7
	Total, 6 hours	312.5	+ .17	+10.2	+ 3.2	239.1	141.5	467.4
	1 a. m. to 3 a. m...	113.7	− .10	− 6.0	....	89.3	52.9	160.6
	3 a. m. to 5 a. m...	84.9	− .08	− 4.8	....	80.6	47.7	127.8
	5 a. m. to 7 a. m...	110.9	+ .20	+12.0	....	84.0	49.7	172.6
	Total, 6 hours	309.5	+ .02	+ 1.2	....	253.9	150.3	461.0
	Total, 1 day..	1,395.1	+ .20	+12.0	+27.2	1,001.3	592.7	2,027.0

TABLE 123.—*Summary of calorimetric measurements, etc.*—Continued.

Date.	Period.	(a) Heat measured in terms of C_{20}.	(b) Change of temperature of calorimeter.	(c) Capacity correction of calorimeter, $b \times 60$.	(d) Correction due to temperature of food and dishes.	(e) Water vaporized, equals total excess in outgoing air plus excess residual vapor.	(f) Heat rendered latent in vaporization of water, $e \times 0.592$.	(g) Total heat determined, $a+c+d+f$.
1901.	*Preliminary to experiment No. 40.*	*Calories.*	*Degrees.*	*Cals.*	*Cals.*	*Grams.*	*Calories.*	*Calories.*
Feb. 25–26.....	7 p. m. to 9 p. m ...	200.0	−0.01	− 0.6	....	84.6	50.1	249.5
	9 p. m. to 11 p. m ..	199.3	+ .04	+ 2.4	....	77.0	45.6	247.3
	11 p. m. to 1 a. m ..	127.5	− .02	− 1.2	....	91.5	54.2	180.5
	Total, 6 hours	526.8	+ .01	+ .6	....	253.1	149.9	677.3
	1 a. m. to 3 a. m ...	117.7	− .02	− 1.2	....	86.2	51.0	167.5
	3 a. m. to 5 a. m ...	95.3	+ .01	+ .6	....	83.3	49.3	145.2
	5 a. m. to 7 a. m ...	115.4	− .02	− 1.2	....	83.9	49.7	163.9
	Total, 6 hours	328.4	− .03	− 1.8	....	253.4	150.0	476.6
	Total, ½ day..	855.2	− .02	− 1.2	....	506.5	299.9	1,153.9
	Experiment No. 40.							
26–27.....	7 a. m. to 9 a. m ...	447.4	+ .04	+ 2.4	+ 8.2	107.5	63.6	521.6
	9 a. m. to 11 a. m ..	772.4	+ .04	+ 2.4	+ 3.0	104.0	61.6	839.4
	11 a. m. to 1 p. m ..	696.5	− .03	− 1.8	....	108.9	64.5	759.2
	Total, 6 hours	1,916.3	+ .05	+ 3.0	+11.2	320.4	189.7	2,120.2
	1 p. m. to 3 p. m ...	520.0	+ .48	+28.8	+ 6.0	109.9	65.1	619.9
	3 p. m. to 5 p. m ...	768.1	− .37	−22.2	+ 5.0	107.0	63.3	814.2
	5 p. m. to 7 p. m ...	588.5	− .14	− 8.4	+ 6.0	108.3	64.1	650.2
	Total, 6 hours	1,876.6	− .03	− 1.8	+17.0	325.2	192.5	2,084.3
	7 p. m. to 9 p. m...	220.6	+ .07	+ 4.2	+ 8.2	94.1	55.7	288.7
	9 p. m. to 11 p. m ..	209.4	+ .01	+ .6	+ 3.1	94.7	56.1	269.2
	11 p. m. to 1 a. m ..	109.9	+ .02	+ 1.2	....	106.0	62.7	173.8
	Total, 6 hours	539.9	+ .10	+ 6.0	+11.3	294.8	174.5	731.7
	1 a. m. to 3 a. m ...	101.5	− .04	− 2.4	....	100.8	59.7	158.8
	3 a. m. to 5 a. m ...	90.1	− .01	− .6	....	97.7	57.8	147.3
	5 a. m. to 7 a. m ...	108.4	+ .11	+ 6.6	....	100.8	59.7	174.7
	Total, 6 hours	300.0	+ .06	+ 3.6	....	299.3	177.2	480.8
	Total, 1 day..	4,632.8	+ .18	+10.8	+39.5	1,239.7	733.9	5,417.0
27–28.....	7 a. m. to 9 a. m ...	360.9	+ .53	+31.8	+ 7.7	105.5	62.5	462.9
	9 a. m. to 11 a. m ..	745.3	− .81	−48.6	+ 4.5	112.4	66.5	767.7
	11 a. m. to 1 p. m ..	648.1	+ .11	+ 6.6	....	102.3	60.6	715.3
	Total, 6 hours	1,754.3	− .17	−10.2	+12.2	320.2	189.6	1,945.9
	1 p. m. to 3 p. m ...	483.4	+ .10	+ 6.0	+ 6.0	96.6	57.2	552.6
	3 p. m. to 5 p. m ...	728.1	+ .25	+15.0	+ 5.0	118.0	69.9	818.0
	5 p. m. to 7 p. m ...	579.3	− .26	−15.6	+ 6.6	112.2	66.4	636.7
	Total, 6 hours	1,790.8	+ .09	+ 5.4	+17.6	326.8	193.5	2,007.3
	7 p. m. to 9 p. m ...	237.2	− .05	− 3.0	....	96.1	56.9	291.1
	9 p. m. to 11 p. m ..	160.9	+ .01	+ .6	+ 3.3	94.3	55.8	220.6
	11 p. m. to 1 a. m ..	96.7	+ .07	+ 4.2	....	106.6	63.1	164.0
	Total, 6 hours	494.8	+ .03	+ 1.8	+ 3.3	297.0	175.8	675.7

TABLE 123.—*Summary of calorimetric measurements, etc.*—Continued.

Date.	Period.	(*a*) Heat measured in terms of C_{20}.	(*b*) Change of temperature of calorimeter.	(*c*) Capacity correction of calorimeter, $b \times 60$.	(*d*) Correction due to temperature of food and dishes.	(*e*) Water vaporized, equals total excess in outgoing air plus excess residual vapor.	(*f*) Heat rendered latent in vaporization of water, $e \times 0.592$.	(*g*) Total heat determined, $a+c+d+f$.
1901.	*Experiment No. 40*—Continued.	*Calories.*	*Degrees.*	*Cals.*	*Cals.*	*Grams.*	*Calories.*	*Calories.*
Feb. 27–28.....	1 a. m. to 3 a. m...	108.8	−0.07	− 4.2	....	96.7	57.2	161.8
	3 a. m. to 5 a. m...	105.0	− .02	− 1.2	....	93.9	55.6	159.4
	5 a. m. to 7 a. m...	108.4	+ .02	+ 1.2	....	89.0	52.7	162.3
	Total, 6 hours	322.2	− .07	− 4.2	....	279.6	165.5	483.5
	Total, 1 day..	4,362.1	− .12	− 7.2	+ 33.1	1,223.6	724.4	5,112.4
28–Mar. 1.	7 a. m. to 9 a. m...	430.2	− .19	−11.4	+ 7.0	99.9	59.1	484.9
	9 a. m. to 11 a. m..	755.0	+ .24	+14.4	+ 4.2	106.1	62.8	836.4
	11 a. m. to 1 p. m..	651.4	− .11	− 6.6	....	102.7	60.8	705.6
	Total, 6 hours	1,836.6	− .06	− 3.6	+ 11.2	308.7	182.7	2,026.9
	1 p. m. to 3 p. m...	457.5	+ .03	+ 1.8	+ 5.1	107.6	63.7	528.1
	3 p. m. to 5 p. m...	723.0	− .07	− 4.2	+ 5.0	103.5	61.3	785.1
	5 p. m. to 7 p. m...	580.1	+ .06	+ 3.6	....	107.2	63.5	647.2
	Total, 6 hours	1,760.6	+ .02	+ 1.2	+ 10.1	318.3	188.5	1,960.4
	7 p. m. to 9 p. m...	213.0	+ .03	+ 1.8	+ 8.8	100.2	59.3	282.9
	9 p. m. to 11 p. m..	197.2	+ .04	+ 2.4	+ 3.5	94.7	56.1	259.2
	11 p. m. to 1 a. m..	105.1	+ .03	+ 1.8	....	100.7	59.6	166.5
	Total, 6 hours	515.3	+ .10	+ 6.0	+ 12.3	295.6	175.0	708.6
	1 a. m. to 3 a. m...	112.3	− .01	− .6	....	99.6	59.0	170.7
	3 a. m. to 5 a. m...	95.0	+ .01	+ .6	....	90.1	53.3	148.9
	5 a. m. to 7 a. m...	100.7	− .01	− .6	....	93.8	55.5	155.6
	Total, 6 hours	308.0	− .01	− .6	....	283.5	167.8	475.2
	Total, 1 day .	4,420.5	+ .05	+ 3.0	+ 33.6	1,206.1	714.0	5,171.1
Mar. 1–2.......	7 a. m. to 9 a. m...	416.9	− .10	− 6.0	+ 9.3	102.7	60.8	481.0
	9 a. m. to 11 a. m..	724.3	+ .07	+ 4.2	+ 4.0	108.3	64.1	796.6
	11 a. m. to 1 p. m..	649.9	− .02	− 1.2	....	93.7	55.5	704.2
	Total, 6 hours	1,791.1	− .05	− 3.0	+ 13.3	304.7	180.4	1,981.8
	1 p. m. to 3 p. m...	461.7	− .04	− 2.4	+ 4.9	97.9	58.0	522.2
	3 p. m. to 5 p. m...	730.7	+ .17	+10.2	+ 4.5	108.0	63.9	809.3
	5 p. m. to 7 p. m...	631.1	− .09	− 5.4	+ 7.6	109.4	64.8	698.1
	Total, 6 hours	1,823.5	+ .04	+ 2.4	+ 17.0	315.3	186.7	2,029.6
	7 p. m. to 9 p. m...	206.4	....	....	+ 2.0	93.7	55.5	263.9
	9 p. m. to 11 p. m..	201.5	+ .01	+ .6	....	92.4	54.7	256.8
	11 p. m. to 1 a. m..	98.8	+ .07	+ 4.2	....	105.8	62.6	165.6
	Total, 6 hours	506.7	+ .08	+ 4.8	+ 2.0	291.9	172.8	686.3
	1 a. m. to 3 a. m...	98.7	+ .01	+ .6	....	99.9	59.1	158.4
	3 a. m. to 5 a. m...	98.0	− .06	− 3.6	....	98.3	58.2	152.6
	5 a. m. to 7 a. m...	126.6	....	....	....	95.1	56.3	182.9
	Total, 6 hours	323.3	− .05	− 3.0	....	293.3	173.6	493.9
	Total, 1 day .	4,444.6	+ .02	+ 1.2	+ 32.3	1,205.2	713.5	5,191.6
	Total, 4 days.	17,860.0	+ .13	+ 7.8	+138.5	4,874.6	2,885.8	20,892.1

TABLE 123.—*Summary of calorimetric measurements, etc.*—Continued.

Date.	Period.	(*a*) Heat measured in terms of C_{20}.	(*b*) Change of temperature of calorimeter.	(*c*) Capacity correction of calorimeter, $b \times 60$.	(*d*) Correction due to temperature of food and dishes.	(*e*) Water vaporized, equals total excess in outgoing air plus excess residual vapor.	(*f*) Heat rendered latent in vaporization of water, $e \times 0.592$.	(*g*) Total heat determined, $a+c+d+f$.
1901.	*Experiment No. 41.*	*Calories.*	*Degrees.*	*Cals.*	*Cals.*	*Grams.*	*Calories.*	*Calories.*
Mar. 2–3.......	7 a. m. to 9 a. m...	426.3	−0.09	− 5.4	+10.0	108.3	64.1	495.0
	9 a. m. to 11 a. m..	736.6	− .02	− 1.2	+ 4.5	104.5	61.9	801.8
	11 a. m. to 1 p. m..	627.0	+ .03	+ 1.8	....	97.2	57.5	686.3
	Total, 6 hours	1,789.9	− .08	− 4.8	+14.5	310.0	183.5	1,983.1
	1 p. m. to 3 p. m...	498.4	+ .03	+ 1.8	+ 6.0	109.6	64.9	571.1
	3 p. m. to 5 p. m...	734.1	....	....	+ 4.0	108.3	64.1	820.2
	5 p. m. to 7 p. m...	577.3	+ .08	+ 4.8	+ 8.5	111.2	65.8	656.4
	Total, 6 hours	1,809.8	+ .11	+ 6.6	+18.5	329.1	194.8	2,029.7
	7 p. m. to 9 p. m...	218.2	− .07	− 4.2	+ 2.2	94.8	56.1	272.3
	9 p. m. to 11 p. m..	207.7	+ .05	+ 3.0	....	97.2	57.5	268.2
	11 p. m. to 1 a. m..	108.4	+ .15	+ 9.0	....	111.9	66.3	183.7
	Total, 6 hours	534.3	+ .13	+ 7.8	+ 2.2	303.9	179.9	724.2
	1 a. m. to 3 a. m...	97.9	− .05	− 3.0	....	99.7	59.0	153.9
	3 a. m. to 5 a. m...	98.3	+ .03	+ 1.8	....	100.8	59.7	159.8
	5 a. m. to 7 a. m...	124.4	− .03	− 1.8	....	101.3	60.0	182.6
	Total, 6 hours	320.6	− .05	− 3.0	....	301.8	178.7	496.3
	Total, 1 day .	4,454.6	+ .11	+ 6.6	+35.2	1,244.8	736.9	5,233.3
3–4.......	7 a. m. to 9 a. m...	410.7	− .04	− 2.4	+10.0	105.8	62.6	480.9
	9 a. m. to 11 a. m..	731.6	− .01	− .6	+ 5.0	109.7	64.9	800.9
	11 a. m. to 1 p. m..	635.9	+ .08	+ 4.8	....	113.7	67.3	708.0
	Total, 6 hours	1,778.2	+ .03	+ 1.8	+15.0	329.2	194.8	1,989.8
	1 p. m. to 3 p. m...	464.3	− .05	− 3.0	+ 5.4	100.9	59.7	526.4
	3 p. m. to 5 p. m...	705.8	+ .10	+ 6.0	+ 4.6	114.2	67.6	784.0
	5 p. m. to 7 p. m...	581.3	+ .06	+ 3.6	+ 8.2	112.7	66.7	659.8
	Total, 6 hours	1,751.4	+ .11	+ 6.6	+18.2	327.8	194.0	1,970.2
	7 p. m. to 9 p. m...	260.7	....	....	+ 3.2	93.5	55.4	259.3
	9 p. m. to 11 p. m..	188.7	− .01	− .6	....	91.7	54.3	242.4
	11 p. m. to 1 a. m..	88.3	+ .06	+ 3.6	....	101.5	60.1	152.0
	Total, 6 hours	477.7	+ .05	+ 3.0	+ 3.2	286.7	169.8	653.7
	1 a. m. to 3 a. m...	116.9	− .08	− 4.8	....	101.3	60.0	172.1
	3 a. m. to 5 a. m...	112.7	− .14	− 8.4	....	94.8	56.1	160.4
	5 a. m. to 7 a. m...	118.3	+ .15	+ 9.0	....	99.6	59.0	186.3
	Total, 6 hours	347.9	− .07	− 4.2	....	295.7	175.1	518.8
	Total, 1 day..	4,355.2	+ .12	+ 7.2	+36.4	1,239.4	733.7	5,132.5
4–5.......	7 a. m. to 9 a. m...	449.3	+ .17	+10.2	+10.6	105.3	62.3	532.4
	9 a. m. to 11 a. m..	770.8	− .11	− 6.6	+ 4.0	109.8	65.0	833.2
	11 a. m. to 1 p. m..	634.5	− .01	− .6	....	103.7	61.4	695.3
	Total, 6 hours	1,854.6	+ .05	+ 3.0	+14.6	318.8	188.7	2,060.9

TABLE 123.—*Summary of calorimetric measurements, etc.*—Continued.

Date.	Period.	(*a*) Heat measured in terms of C_{20}.	(*b*) Change of temperature of calorimeter.	(*c*) Capacity correction of calorimeter, $b \times 60$.	(*d*) Correction due to temperature of food and dishes.	(*e*) Water vaporized, equals total excess in outgoing air plus excess residual vapor.	(*f*) Heat rendered latent in vaporization of water, $e \times 0.592$.	(*g*) Total heat determined, $a+c+d+f$.
	Experiment No. 41—Continued.							
1901.		*Calories.*	*Degrees.*	*Cals.*	*Cals.*	*Grams.*	*Calories.*	*Calories.*
Mar. 4–5.......	1 p. m. to 3 p. m...	458.8	−0.14	− 8.4	+ 5.5	99.5	58.9	514.8
	3 p. m. to 5 p. m...	702.6	+ .04	+ 2.4	+ 4.5	106.2	62.9	772.4
	5 p. m. to 7 p. m...	571.2	+ .05	+ 3.0	+ 6.6	116.2	68.8	649.6
	Total, 6 hours	1,732.6	− .05	− 3.0	+ 16.6	321.9	190.6	1,936.8
	7 p. m. to 9 p. m...	225.2	+ .01	+ .6	+ 2.6	92.3	54.6	283.0
	9 p. m. to 11 p. m..	204.1	+ .05	+ 3.0	....	95.7	56.7	263.8
	11 p. m. to 1 a. m..	100.8	− .02	− 1.2	....	102.1	60.4	160.0
	Total, 6 hours	530.1	+ .04	+ 2.4	+ 2.6	290.1	171.7	706.8
	1 a. m. to 3 a. m...	119.2	− .03	− 1.8	....	105.7	62.6	180.0
	3 a. m. to 5 a. m...	97.1	− .01	− .6	....	95.6	56.6	153.1
	5 a. m. to 7 a. m...	122.8	+ .02	+ 1.2	....	101.2	59.9	183.9
	Total, 6 hours	339.1	− .02	− 1.2	....	302.5	179.1	517.0
	Total, 1 day..	4,456.4	+ .02	+ 1.2	+ 33.8	1,233.3	730.1	5,221.5
5–6.......	7 a. m. to 9 a. m...	422.7	+ .12	+ 7.2	+ 10.3	101.5	60.1	500.3
	9 a. m. to 11 a. m..	825.0	− .15	− 9.0	+ 4.5	115.0	68.1	888.6
	11 a. m. to 1 p. m..	763.3	+ .19	+11.4	....	110.3	65.3	840.0
	Total, 6 hours	2,011.0	+ .16	+ 9.6	+ 14.8	326.8	193.5	2,228.9
	1 p. m. to 3 p. m...	504.2	− .37	−22.2	+ 5.7	106.9	63.3	551.0
	3 p. m. to 5 p. m...	705.6	+ .14	+ 8.4	+ 5.1	96.5	57.1	776.2
	5 p. m. to 7 p. m...	539.9	+ .03	+ 1.8	....	112.2	66.4	608.1
	Total, 6 hours	1,749.7	− .20	−12.0	+ 10.8	315.6	186.8	1,935.3
	7 p. m. to 9 p. m...	208.1	+ .03	+ 1.8	+ 6.5	99.4	58.8	275.2
	9 p. m. to 11 p. m..	194.8	+ .05	+ 3.0	+ 3.2	97.8	57.9	258.9
	11 p. m. to 1 a. m..	106.3	+ .01	+ .6	....	104.5	61.9	168.8
	Total, 6 hours	509.2	+ .09	+ 5.4	+ 9.7	301.7	178.6	702.9
	1 a. m. to 3 a. m...	112.2	+ .05	+ 3.0	....	105.3	62.3	177.5
	3 a. m. to 5 a. m...	104.2	− .07	− 4.2	....	102.9	60.9	160.9
	5 a. m. to 7 a. m...	115.8	− .02	− 1.2	....	100.1	59.3	173.9
	Total, 6 hours	332.2	− .04	− 2.4	....	308.3	182.5	512.3
	Total, 1 day..	4,602.1	+ .01	+ .6	+ 35.3	1,252.4	741.4	5,379.4
	Total, 4 days.	17,868.3	+ .26	+15.6	+140.7	4,969.9	2,942.1	20,966.7
	Experiment No. 42.							
6–7.......	7 a. m. to 9 a. m...	173.0	− .02	− 1.2	....	91.4	54.1	225.9
	9 a. m. to 11 a. m..	102.4	+ .06	+ 3.6	....	70.5	41.7	147.7
	11 a. m. to 1 p. m..	99.0	− .02	− 1.2	....	84.9	50.3	148.1
	Total, 6 hours	374.4	+ .02	+ 1.2	....	246.8	146.1	521.7
	1 p. m. to 3 p. m...	122.0	− .08	− 4.8	....	77.6	45.9	163.1
	3 p. m. to 5 p. m...	102.9	+ .08	+ 4.8	....	85.2	50.4	158.1
	5 p. m. to 7 p. m...	113.0	+ .02	− 1.2	....	88.1	52.2	166.4
	Total, 6 hours	337.9	+ .02	+ 1.2	....	250.9	148.5	487.6

TABLE 123.—*Summary of calorimetric measurements, etc.*—Continued.

Date.	Period.	(*a*) Heat measured in terms of C_{20}.	(*b*) Change of temperature of calorimeter.	(*c*) Capacity correction of calorimeter, $b\times60$.	(*d*) Correction due to temperature of food and dishes.	(*e*) Water vaporized, equals total excess in outgoing air plus excess residual vapor.	(*f*) Heat rendered latent in vaporization of water, $e\times0.592$.	(*g*) Total heat determined, $a+c+d+f$.
	Experiment No. 42—Continued.							
1901.		*Calories.*	*Degrees.*	*Cals.*	*Cals.*	*Grams.*	*Calories.*	*Colories.*
Mar. 6-7.......	7 p. m. to 9 p. m...	116.9	−0.09	− 5.4	....	82.0	48.5	160.0
	9 p. m. to 11 p. m..	130.1	+ .05	+ 3.0	....	81.7	48.4	181.5
	11 p. m. to 1 a. m..	92.1	− .02	− 1.2	....	79.0	46.8	137.7
	Total, 6 hours	339.1	− .06	− 3.6	....	242.7	143.7	479.2
	1 a. m. to 3 a. m...	101.8	+ .02	+ 1.2	....	74.0	43.8	146.8
	3 a. m. to 5 a. m...	99.1	....	....	....	76.1	45.1	144.2
	5 a. m. to 7 a. m...	111.3	+ .14	+ 8.4	....	79.2	46.9	166.6
	Total, 6 hours	312.2	+ .16	+ 9.6	....	229.3	135.8	457.6
	Total, 1 day..	1,363.6	+ .14	+ 8.4	....	969.7	574.1	1,946.1
	Experiment No. 43.							
29-30.......	7 a. m. to 9 a. m...	438.2	+ .41	+24.6	− 9.9	101.1	59.8	512.7
	9 a. m. to 11 a. m..	734.8	− .44	−26.4	+ 4.5	108.8	64.4	777.3
	11 a. m. to 1 p. m..	632.9	+ .12	+ 7.2	....	102.6	60.7	700.8
	Total, 6 hours	1,805.9	+ .09	+ 5.4	− 5.4	312.5	184.9	1,990.8
	1 p. m. to 3 p. m...	568.8	+ .69	+41.4	−14.0	114.2	67.6	663.8
	3 p. m. to 5 p. m...	805.2	− .45	−27.0	+ 4.5	108.9	64.5	847.2
	5 p. m. to 7 p. m...	644.7	− .30	−18.0	−18.7	110.9	65.6	673.6
	Total, 6 hours	2,018.7	− .06	− 3.6	−28.2	334.0	197.7	2,184.6
	7 p. m. to 9 p. m...	229.8	+ .05	+ 3.0	+ 4.0	97.0	57.4	294.2
	9 p. m. to 11 p. m..	225.1	+ .02	+ 1.2	+ 2.4	92.5	54.8	283.5
	11 p. m. to 1 a. m..	122.3	− .06	− 3.6	....	94.3	55.8	174.5
	Total, 6 hours	577.2	+ .01	+ .6	+ 6.4	283.8	168.0	752.2
	1 a. m. to 3 a. m...	124.2	− .02	− 1.2	....	103.3	61.2	184.2
	3 a. m. to 5 a. m...	125.1	− .01	− .6	....	96.7	57.2	181.7
	5 a. m. to 7 a. m...	108.7	+ .12	+ 7.2	....	91.5	54.2	170.1
	Total, 6 hours	358.0	+ .09	+ 5.4	....	291.5	172.6	536.0
	Total, 1 day..	4,759.8	+ .13	+ 7.8	−27.2	1,221.8	723.2	5,463.6
30-31.......	7 a. m. to 9 a. m...	471.4	+ .42	+25.2	−15.0	104.1	61.6	543.2
	9 a. m. to 11 a. m..	787.5	− .10	− 6.0	+ 4.5	116.9	69.2	855.2
	11 a. m. to 1 p. m..	669.5	− .03	− 1.8	....	105.5	62.5	730.2
	Total, 6 hours	1,928.4	+ .29	+17.4	−10.5	326.5	193.3	2,128.6
	1 p. m. to 3 p. m...	487.0	− .04	− 2.4	−20.9	102.9	60.9	524.6
	3 p. m. to 5 p. m...	654.6	+ .02	+ 1.2	+ 4.5	102.1	60.4	720.7
	5 p. m. to 7 p. m...	488.4	+ .03	+ 1.8	−22.8	109.0	64.5	531.9
	Total, 6 hours	1,630.0	+ .01	+ .6	−39.2	314.0	185.8	1,777.2
	7 p. m. to 9 p. m...	264.5	− .11	− 6.6	+ 4.5	101.6	60.2	322.6
	9 p. m. to 11 p. m..	231.8	− .04	− 2.4	+ 2.4	97.0	57.4	289.2
	11 p. m. to 1 a. m..	122.5	+ .05	+ 3.0	....	100.2	59.3	184.8
	Total, 6 hours	618.8	− .10	− 6.0	+ 6.9	298.8	176.9	796.6

TABLE 123.—*Summary of calorimetric measurements, etc.*—Continued.

Date.	Period.	(*a*) Heat measured in terms of C_{20}.	(*b*) Change of temperature of calorimeter.	(*c*) Capacity correction of calorimeter, $b \times 60$.	(*d*) Correction due to temperature of food and dishes.	(*e*) Water vaporized, equals total excess in outgoing air plus excess residual vapor.	(*f*) Heat rendered latent in vaporization of water, $e \times 0.592$.	(*g*) Total heat determined, $a+c+d+f$.
	Experiment No. 43—Continued.							
1901.		*Calories.*	*Degrees.*	*Cals.*	*Cals.*	*Grams.*	*Calories.*	*Calories.*
Mar. 30–31.....	1 a. m. to 3 a. m...	121.9	....	....	....	98.8	58.5	180.4
	3 a. m. to 5 a. m...	103.5	....	....	....	97.1	57.5	161.0
	5 a. m. to 7 a. m...	117.5	+0.29	+17.4	....	110.2	65.2	200.1
	Total, 6 hours	342.9	+ .29	+17.4	....	306.1	181.2	541.5
	Total, 1 day..	4,520.1	+ .49	+29.4	− 42.8	1,245.4	737.2	5,243.9
31–Apr. 1.	7 a. m. to 9 a. m...	493.4	− .21	−12.6	− 21.5	102.4	60.6	519.9
	9 a. m. to 11 a. m..	677.9	− .17	−10.2	+ 4.5	95.9	56.8	729.0
	11 a. m. to 1 p. m..	590.6	− .03	− 1.8	....	101.5	60.1	648.9
	Total, 6 hours	1,761.9	− .41	−24.6	− 17.0	299.8	177.5	1,897.8
	1 p. m. to 3 p. m...	538.8	+ .55	+33.0	− 22.9	106.5	63.0	611.9
	3 p. m. to 5 p. m...	757.2	− .30	−18.0	+ 3.5	94.7	56.0	798.7
	5 p. m. to 7 p. m...	522.5	− .09	− 5.4	− 23.4	105.2	62.3	556.0
	Total, 6 hours	1,818.5	+ .16	+ 9.6	− 42.8	306.4	181.3	1,966.6
	7 p. m. to 9 p. m...	238.5	− .05	− 3.0	+ 3.5	90.5	53.6	292.6
	9 p. m. to 11 p. m..	208.7	− .06	− 3.6	+ 2.1	88.3	52.3	259.5
	11 p. m. to 1 a. m..	102.0	+ .09	+ 5.4	....	100.4	59.4	166.8
	Total, 6 hours	549.2	− .02	− 1.2	+ 5.6	279.2	165.3	718.9
	1 a. m to 3 a. m....	108.0	....	....	....	100.0	59.2	167.2
	3 a. m. to 5 a. m...	103.0	+ .01	+ .6	....	99.8	59.1	162.7
	5 a. m. to 7 a. m...	105.1	+ .10	+ 6.0	....	93.9	55.6	166.7
	Total, 6 hours	316.1	+ .11	+ 6.6	....	293.7	173.9	496.6
	Total, 1 day..	4,445.7	− .16	− 9.6	− 54.2	1,179.1	698.0	5,079.9
Apr. 1–2.......	7 a. m. to 9 a. m...	434.8	+ .11	+ 6.6	− 17.9	99.1	58.7	482.2
	9 a. m. to 11 a. m..	723.8	− .08	− 4.8	+ 3.5	90.4	53.5	776.0
	11 a. m. to 1 p. m..	559.4	− .06	− 3.6	....	91.7	54.3	610.1
	Total, 6 hours	1,718.0	− .03	− 1.8	− 14.4	281.2	166.5	1,868.3
	1 p. m. to 3 p. m...	484.3	− .07	− 4.2	− 25.6	88.4	52.3	506.8
	3 p. m. to 5 p. m...	680.0	+ .02	+ 1.2	+ 3.5	101.6	60.2	744.9
	5 p. m. to 7 p. m...	588.4	− .02	− 1.2	− 22.6	99.1	58.7	623.3
	Total, 6 hours	1,752.7	− .07	− 4.2	− 44.7	289.1	171.2	1,875.0
	7 p. m. to 9 p. m...	242.1	....	....	+ 5.0	87.7	51.9	299.0
	9 p. m. to 11 p. m..	241.9	+ .05	+ 3.0	+ 2.4	96.2	56.9	304.2
	11 p. m. to 1 a. m..	126.2	− .04	− 2.4	....	103.0	61.0	184.8
	Total, 6 hours	610.2	+ .01	+ .6	+ 7.4	286.9	169.8	788.0
	1 a. m. to 3 a. m...	125.7	+ .03	+ 1.8	....	102.2	60.5	188.0
	3 a. m to 5 a. m....	105.4	− .02	− 1.2	....	92.6	54.8	159.0
	5 a. m. to 7 a. m...	87.2	+ .20	+12.0	....	91.3	54.0	153.2
	Total, 6 hours	318.3	+ .21	+12.6	....	286.1	169.3	500.2
	Total, 1 day..	4,399.2	+ .12	+ 7.2	− 51.7	1,143.3	676.8	5,031.5
	Total, 4 days.	18,124.8	+ .58	+34.8	−175.9	4,789.6	2,835.2	20,818.9

TABLE 123.—*Summary of calorimetric measurements, etc.*—Continued.

Date.	Period.	(*a*) Heat measured in terms of C_{20}.	(*b*) Change of temperature of calorimeter.	(*c*) Capacity correction of calorimeter, $b\times 60$.	(*d*) Correction due to temperature of food and dishes.	(*e*) Water vaporized, equals total excess in outgoing air plus excess residual vapor.	(*f*) Heat rendered latent in vaporization of water, $e\times 0.592$.	(*g*) Total heat determined, $a+c+d+f$.
1901.	*Experiment No. 44.*	*Calories.*	*Degrees.*	*Cals.*	*Cals.*	*Grams.*	*Calories.*	*Calories.*
Apr. 2-3	7 a. m. to 9 a. m.	486.0	−0.21	−12.6	−18.9	95.8	56.7	511.2
	9 a. m. to 11 a. m.	668.4	+ .08	+ 4.8	+ 4.3	98.9	58.5	736.0
	11 a. m. to 1 p. m.	614.7	− .13	− 7.8	....	97.4	57.7	664.6
	Total, 6 hours	1,769.1	− .26	−15.6	−14.6	292.1	172.9	1,911.8
	1 p. m. to 3 p. m.	458.4	+ .36	+21.6	−21.5	99.0	58.6	517.1
	3 p. m. to 5 p. m.	712.9	− .20	−12.0	+ 5.5	100.2	59.3	765.7
	5 p. m. to 7 p. m.	728.6	− .09	− 5.4	−21.1	103.2	61.1	763.2
	Total, 6 hours	1,899.9	+ .07	+ 4.2	−37.1	302.4	179.0	2,046.0
	7 p. m. to 9 p. m.	246.9	− .01	− .6	+ 2.9	96.8	57.3	306.5
	9 p. m. to 11 p. m.	210.7	+ .04	+ 2.4	+ 2.4	93.4	55.3	270.8
	11 p. m. to 1 a. m.	125.7	− .01	− .6	....	99.2	58.7	183.8
	Total, 6 hours	583.3	+ .02	+ 1.2	+ 5.3	289.4	171.3	761.1
	1 a. m. to 3 a. m.	110.9	− .01	− .6	....	97.4	57.7	168.0
	3 a. m. to 5 a. m.	100.5	− .04	− 2.4	....	93.3	55.2	153.3
	5 a. m. to 7 a. m.	94.3	+ .31	+18.6	....	93.5	55.4	168.3
	Total, 6 hours	305.7	+ .26	+15.6	....	284.2	168.3	489.6
	Total, 1 day	4,558.0	+ .09	+ 5.4	−46.4	1,168.1	691.5	5,208.5
3-4	7 a. m. to 9 a. m.	414.6	− .25	−15.0	−19.8	86.2	51.0	430.8
	9 a. m. to 11 a. m.	676.8	+ .02	+ 1.2	+ 3.8	93.3	55.2	737.0
	11 a. m. to 1 p. m.	615.0	+ .02	+ 1.2	....	90.3	53.5	669.7
	Total, 6 hours	1,706.4	− .21	−12.6	−16.0	269.8	159.7	1,837.5
	1 p. m. to 3 p. m.	471.4	+ .41	+24.6	−20.0	95.4	56.5	532.5
	3 p. m. to 5 p. m.	765.0	− .21	−12.6	+ 4.4	91.5	54.2	811.0
	5 p. m. to 7 p. m.	632.3	− .24	−14.4	−16.1	110.7	65.5	667.3
	Total, 6 hours	1,868.7	− .04	− 2.4	−31.7	297.6	176.2	2,010.8
	7 p. m. to 9 p. m.	236.4	− .03	− 1.8	+ 3.8	91.0	53.9	292.3
	9 p. m. to 11 p. m.	209.2	+ .08	+ 4.8	+ 2.4	87.0	51.5	267.9
	11 p. m. to 1 a. m.	108.6	....	....	....	92.1	54.5	163.1
	Total, 6 hours	554.2	+ .05	+ 3.0	+ 6.2	270.1	159.9	723.3
	1 a. m. to 3 a. m.	95.3	− .04	− 2.4	....	93.1	55.1	148.0
	3 a. m. to 5 a. m.	104.4	+ .02	+ 1.2	....	96.1	56.9	162.5
	5 a. m. to 7 a. m.	117.5	− .06	− 3.6	....	97.1	57.5	171.4
	Total, 6 hours	317.2	− .08	− 4.8	....	286.3	169.5	481.9
	Total, 1 day	4,446.5	− .28	−16.8	−41.5	1,123.8	665.3	5,053.5
4-5	7 a. m. to 9 a. m.	438.7	+ .03	+ 1.8	−19.6	89.2	52.8	473.7
	9 a. m. to 11 a. m.	675.7	+ .11	+ 6.6	+ 4.4	99.5	58.9	745.6
	11 a. m. to 1 p. m.	577.8	− .17	−10.2	....	107.1	63.4	631.0
	Total, 6 hours	1,692.2	− .03	− 1.8	−15.2	295.8	175.1	1,850.3

TABLE 123.—*Summary of calorimetric measurements, etc.*—Continued.

Date.	Period.	(*a*) Heat measured in terms of C_{20}.	(*b*) Change of temperature of calorimeter.	(*c*) Capacity correction of calorimeter, *b*×60.	(*d*) Correction due to temperature of food and dishes.	(*e*) Water vaporized, equals total excess in outgoing air plus excess residual vapor.	(*f*) Heat rendered latent in vaporization of water, *e*×0.592.	(*g*) Total heat determined, *a*+*c*+*d*+*f*.
	Experiment No. 44—Continued.							
1901.		*Calories.*	*Degrees.*	*Cals.*	*Cals.*	*Grams.*	*Calories.*	*Calories.*
Apr. 4–5	1 p. m. to 3 p. m	503.8	+0.56	+33.6	− 21.1	103.7	61.4	577.7
	3 p. m. to 5 p. m	796.9	− .64	−38.4	+ 5.5	106.5	63.0	827.0
	5 p. m. to 7 p. m	603.1	+ .18	+10.8	− 18.7	102.3	60.6	655.8
	Total, 6 hours	1,903.8	+.10	+ 6.0	− 34.3	312.5	185.0	2,060.5
	7 p. m. to 9 p. m	240.2	− .05	− 3.0	+ 3.8	89.9	53.2	294.2
	9 p. m. to 11 p. m	213.4	+ .13	+ 7.8	+ 2.1	92.1	54.5	277.8
	11 p. m. to 1 a. m	123.0	− .10	− 6.0	....	90.3	53.5	170.5
	Total, 6 hours	576.6	− .02	− 1.2	+ 5.9	272.3	161.2	742.5
	1 a. m. to 3 a. m	100.0	− .02	− 1.2	....	91.4	54.1	152.9
	3 a. m. to 5 a. m	103.9	+ .04	+ 2.4	....	87.9	52.0	158.3
	5 a. m. to 7 a. m	97.3	− .01	− .6	....	91.8	54.3	151.0
	Total, 6 hours	301.2	+ .01	+ .6	....	271.1	160.4	462.2
	Total, 1 day	4,473.8	+ .06	+ 3.6	− 43.6	1,151.7	681.7	5,115.5
5–6	7 a. m. to 9 a. m	451.9	− .13	− 7.8	− 17.6	96.6	57.2	483.7
	9 a. m. to 11 a. m	769.1	+ .11	+ 6.6	+ 4.9	105.6	62.5	843.1
	11 a. m. to 1 p. m	682.0	+ .18	+10.8	....	100.7	59.6	752.4
	Total, 6 hours	1,903.0	+ .16	+ 9.6	− 12.7	302.9	179.3	2,079.2
	1 p. m. to 3 p. m	486.5	+ .30	+18.0	− 22.0	117.8	69.7	552.2
	3 p. m. to 5 p. m	773.8	− .34	−20.4	+ 5.5	103.8	61.5	820.4
	5 p. m. to 7 p. m	657.2	+ .08	+ 4.8	− 18.1	109.4	64.8	708.7
	Total, 6 hours	1,917.5	+ .04	+ 2.4	− 34.6	331.0	196.0	2,081.3
	7 p. m. to 9 p. m	239.7	− .19	−11.4	+ 4.9	93.5	55.4	288.6
	9 p. m. to 11 p. m	220.6	+ .12	+ 7.2	+ 3.5	93.9	55.6	286.9
	11 p. m. to 1 a. m	109.1	− .13	− 7.8	....	100.7	59.6	160.9
	Total, 6 hours	569.4	− .20	−12.0	+ 8.4	288.1	170.6	736.4
	1 a. m. to 3 a. m	127.7	+ .02	+ 1.2	....	101.6	60.1	189.0
	3 a. m. to 5 a. m	95.4	+ .01	+ .6	....	101.2	59.9	155.9
	5 a. m. to 7 a. m	116.1	− .01	− .6	....	100.5	59.5	175.0
	Total, 6 hours	339.2	+ .02	+ 1.2	....	303.3	179.5	519.9
	Total, 1 day	4,729.1	+ .02	+ 1.2	− 38.9	1,225.3	725.4	5,416.8
	Total, 4 days	18,207.4	− .11	− 6.6	−170.4	5,668.9	2,763.9	20,794.3
	Experiment No. 45.							
6–7	7 a. m. to 9 a. m	428.2	....	....	− 20.9	99.6	59.0	466.3
	9 a. m. to 11 a. m	747.5	− .02	− 1.2	+ 4.5	104.3	61.7	812.5
	11 a. m. to 1 p. m	679.9	− .01	− .6	....	109.9	65.1	744.4
	Total, 6 hours	1,855.6	− .03	− 1.8	− 16.4	313.8	185.8	2,023.2
	1 p. m. to 3 p. m	472.0	− .02	− 1.2	− 19.5	103.3	61.2	512.5
	3 p. m. to 5 p. m	725.4	+ .01	+ .6	+ 4.5	106.1	62.8	793.3
	5 p. m. to 7 p. m	535.8	+ .11	+ 6.6	− 19.9	103.1	61.0	583.5
	Total, 6 hours	1,733.2	+ .10	+ 6.0	− 34.9	312.4	185.0	1,889.3

Table 123.—*Summary of calorimetric measurements, etc.*—Continued.

Date.	Period.	(*a*) Heat measured in terms of C_{20}.	(*b*) Change of temperature of calorimeter.	(*c*) Capacity correction of calorimeter, $b \times 60$.	(*d*) Correction due to temperature of food and dishes.	(*e*) Water vaporized, equals total excess in outgoing air plus excess residual vapor.	(*f*) Heat rendered latent in vaporization of water, $e \times 0.592$.	(*g*) Total heat determined, $a+c+d+f$.
1901.	*Experiment No. 45*—Continued.	*Calories.*	*Degrees.*	*Cals.*	*Cals.*	*Grams.*	*Calories.*	*Calories.*
Apr. 6–7	7 p. m. to 9 p. m	217.0	+0.01	+ 0.6	+ 2.4	92.9	55.0	275.0
	9 p. m. to 11 p. m	215.9	+ .02	+ 1.2	+ 1.8	96.1	56.9	275.8
	11 p. m. to 1 a. m	118.2	− .07	− 4.2	....	90.0	53.3	167.3
	Total, 6 hours	551.1	− .04	− 2.4	+ 4.2	279.0	165.2	718.1
	1 a. m. to 3 a. m	118.5	+ .05	+ 3.0	....	103.0	61.0	182.5
	3 a. m. to 5 a. m	133.9	− .08	− 4.8	....	92.2	54.6	183.7
	5 a. m. to 7 a. m	110.0	+ .01	+ .6	....	92.2	54.6	165.2
	Total, 6 hours	362.4	− .02	− 1.2	−47.1	287.4	170.2	531.4
	Total, 1 day	4,502.3	+ .01	+ .6	−47.1	1,192.7	706.2	5,162.0
	Experiment No. 46.							
May 3–4	7 a. m. to 9 a. m	512.9	+ .04	+ 2.4	−13.5	121.5	71.9	573.7
	9 a. m. to 11 a. m	801.6	− .33	−19.8	+ 2.4	128.1	75.8	860.0
	11 a. m. to 1 p. m	633.5	+ .44	+26.4	− 1.7	120.7	71.5	729.7
	Total, 6 hours	1,948.0	+ .15	+ 9.0	−12.8	370.3	219.2	2,163.4
	1 p. m. to 3 p. m	513.1	− .05	− 3.0	−30.1	126.6	75.0	555.0
	3 p. m. to 5 p. m	721.7	+ .06	+ 3.6	− 1.7	119.5	70.7	794.3
	5 p. m. to 7 p. m	671.4	....	....	−40.0	129.1	76.4	707.8
	Total, 6 hours	1,906.2	+ .01	+ .6	−71.8	375.2	222.1	2,057.1
	7 p. m. to 9 p. m	251.6	− .11	− 6.6	+ 4.0	114.8	68.0	317.0
	9 p. m. to 11 p. m	194.0	+ .04	+ 2.4	+ 2.4	114.0	67.5	266.3
	11 p. m. to 1 a. m	129.0	+ .04	+ 2.4	....	129.5	76.7	208.1
	Total, 6 hours	574.6	− .03	− 1.8	+ 6.4	358.3	212.2	791.4
	1 a. m. to 3 a. m	105.9	+ .01	+ .6	....	118.5	70.1	176.6
	3 a. m. to 5 a. m	107.0	− .03	− 1.8	....	115.5	68.4	173.6
	5 a. m. to 7 a. m	96.7	....	....	....	115.0	68.1	164.8
	Total, 6 hours	309.6	− .02	− 1.2	....	349.0	206.6	515.0
	Total, 1 day	4,738.4	+ .11	+ 6.6	−78.2	1,452.8	860.1	5,526.9
4–5	7 a. m. to 9 a. m	453.6	− .03	− 1.8	−22.6	119.5	70.7	499.9
	9 a. m. to 11 a. m	690.3	− .01	− .6	+ 1.2	118.0	69.9	760.8
	11 a. m. to 1 p. m	665.1	− .28	−16.8	− 1.7	121.8	72.1	718.7
	Total, 6 hours	1,809.0	− .32	−19.2	−23.1	359.3	212.7	1,979.4
	1 p. m. to 3 p. m	485.5	+ .43	+25.8	−33.4	115.7	68.5	546.4
	3 p. m. to 5 p. m	718.4	− .19	−11.4	+ .9	127.9	75.7	783.6
	5 p. m. to 7 p. m	556.3	+ .13	+ 7.8	−33.9	118.6	70.2	600.4
	Total, 6 hours	1,760.2	+ .37	+22.2	−66.4	362.2	214.4	1,930.4
	7 p. m. to 9 p. m	249.4	− .01	− .6	+ 4.1	116.8	69.1	322.0
	9 p. m. to 11 p. m	201.0	+ .01	+ .6	+ 3.0	117.0	69.3	273.9
	11 p. m. to 1 a. m	107.1	+ .01	+ .6	− 2.4	125.5	74.3	179.6
	Total, 6 hours	557.5	+ .01	+ .6	+ 4.7	359.3	212.7	775.5

TABLE 123.—*Summary of calorimetric measurements, etc.*—Continued.

Date.	Period.	(*a*) Heat measured in terms of C_{20}.	(*b*) Change of temperature of calorimeter.	(*c*) Capacity correction of calorimeter, $b \times 60$.	(*d*) Correction due to temperature of food and dishes.	(*e*) Water vaporized, equals total excess in outgoing air plus excess residual vapor.	(*f*) Heat rendered latent in vaporization of water, $e \times 0.592$.	(*g*) Total heat determined, $a+c+d+f$.
1901.	*Experiment No. 46*—Continued.	*Calories.*	*Degrees.*	*Cals.*	*Cals.*	*Grams.*	*Calories.*	*Calories.*
May 4–5	1 a. m. to 3 a. m	104.2	−0.02	− 1.2	− 2.4	126.7	75.0	175.6
	3 a. m. to 5 a. m	100.2	− .02	− 1.2	− 2.4	123.0	72.8	169.4
	5 a. m. to 7 a. m	106.4	− .06	− 3.6	− 2.4	112.6	66.7	167.1
	Total, 6 hours	310.8	− .10	− 6.0	− 7.2	362.3	214.5	512.1
	Total, 1 day	4,437.5	− .04	− 2.4	− 92.0	1,443.1	854.3	5,197.4
5–6	7 a. m. to 9 a. m	455.0	+ .07	+ 4.2	− 18.5	116.8	69.2	509.9
	9 a. m. to 11 a. m	688.4	+ .16	+ 9.6	+ 1.2	131.1	77.6	776.8
	11 a. m. to 1 p. m	643.6	− .45	−27.0	− 1.7	113.3	67.1	682.0
	Total, 6 hours	1,787.0	− .22	−13.2	− 19.0	361.2	213.9	1,968.7
	1 p. m. to 3 p. m	474.1	+ .39	+23.4	− 31.6	124.7	73.8	539.7
	3 p. m. to 5 p. m	709.2	− .03	− 1.8	+ 1.7	121.6	72.0	781.1
	5 p. m. to 7 p. m	555.3	+ .11	+ 6.6	− 32.6	130.0	77.0	606.3
	Total, 6 hours	1,738.6	+ .47	+28.2	− 62.5	376.3	222.8	1,927.1
	7 p. m. to 9 p. m	242.4	− .14	− 8.4	+ 6.7	106.5	63.0	303.7
	9 p. m. to 11 p. m	216.5	− .07	− 4.2	+ 4.3	105.3	62.3	278.9
	11 p. m. to 1 a. m	98.7	+ .06	+ 3.6	....	124.5	73.7	176.0
	Total, 6 hours	557.6	− .15	− 9.0	+ 11.0	336.3	199.0	758.6
	1 a. m. to 3 a. m	111.7	− .04	− 2.4	....	122.6	72.6	181.9
	3 a. m. to 5 a. m	105.4	+ .01	+ .6	....	109.8	65.0	171.0
	5 a. m. to 7 a. m	90.5	− .06	− 3.6	....	103.6	61.3	148.2
	Total, 6 hours	307.6	− .09	− 5.4	....	336.0	198.9	501.1
	Total, 1 day	4,390.8	+ .01	+ .6	− 70.5	1,409.8	834.6	5,155.5
6–7	7 a. m. to 9 a. m	428.1	+ .02	+ 1.2	− 20.2	116.0	68.7	477.8
	9 a. m. to 11 a. m	692.7	− .01	− .6	+ 1.4	118.8	70.3	763.8
	11 a. m. to 1 p. m	607.4	+ .02	+ 1.2	− 1.7	127.7	75.6	682.5
	Total, 6 hours	1,728.2	+ .03	+ 1.8	− 20.5	362.5	214.6	1,924.1
	1 p. m. to 3 p. m	481.2	+ .15	+ 9.0	− 33.4	125.4	74.2	531.0
	3 p. m. to 5 p. m	710.5	+ .03	+ 1.8	+ 1.7	120.9	71.6	785.6
	5 p. m. to 7 p. m	530.1	− .06	− 3.6	− 32.3	120.3	71.2	565.4
	Total, 6 hours	1,721.8	+ .12	+ 7.2	− 64.0	366.6	217.0	1,882.0
	7 p. m. to 9 p. m	239.9	− .06	− 3.6	+ 6.0	109.5	64.8	307.1
	9 p. m. to 11 p. m	200.6	− .03	− 1.8	+ 4.5	108.7	64.4	267.7
	11 p. m. to 1 a. m	111.6	+ .07	+ 4.2	....	124.3	73.6	189.4
	Total, 6 hours	552.1	− .02	− 1.2	+ 10.5	342.5	202.8	764.2
	1 a. m. to 3 a. m	106.8	− .04	− 2.4	....	116.6	69.0	173.4
	3 a. m. to 5 a. m	96.8	....	....	....	112.3	66.5	163.3
	5 a. m. to 7 a. m	96.0	+ .05	+ 3.0	....	108.7	64.4	163.4
	Total, 6 hours	299.6	+ .01	+ .6	....	337.6	199.9	500.1
	Total, 1 day	4,301.7	+ .14	+ 8.4	− 74.0	1,409.2	834.3	5,070.4
	Total, 4 days	17,867.4	+ .22	+13.2	−314.7	5,714.9	3,383.3	20,950.2

TABLE 123.—*Summary of calorimetric measurements, etc.*—Continued.

Date.	Period.	(*a*) Heat measured in terms of C_{20}.	(*b*) Change of temperature of calorimeter.	(*c*) Capacity correction of calorimeter, $b \times 60$.	(*d*) Correction due to temperature of food and dishes.	(*e*) Water vaporized, equals total excess in outgoing air plus excess residual vapor.	(*f*) Heat rendered latent in vaporization of water, $e \times 0.592$.	(*g*) Total heat determined, $a+c+d+f$.
1901.	*Experiment No. 47.*	*Calories.*	*Degrees.*	*Cals.*	*Cals.*	*Calories.*	*Calories.*	*Grams.*
May 7–8	7 a. m. to 9 a. m	436.1	+0.08	+ 4.8	−19.9	113.3	67.1	488.1
	9 a. m. to 11 a. m	739.2	+ .10	+ 6.0	+ 2.9	133.9	79.3	827.4
	11 a. m. to 1 p. m	671.6	− .05	− 3.0	− 1.7	118.7	70.3	737.2
	Total, 6 hours	1,846.9	+ .13	+ 7.8	−18.7	365.9	216.7	2,052.7
	1 p. m. to 3 p. m	495.5	− .09	− 5.4	−27.2	124.0	73.4	536.3
	3 p. m. to 5 p. m	698.5	+ .06	+ 3.6	+ 2.7	131.9	78.1	782.9
	5 p. m. to 7 p. m	588.9	+ .01	+ .6	−33.3	116.4	68.9	625.1
	Total, 6 hours	1,782.9	− .02	− 1.2	−57.8	372.3	220.4	1,944.3
	7 p. m. to 9 p. m	228.8	− .14	− 8.4	+ 9.0	97.7	57.8	287.2
	9 p. m. to 11 p. m	200.3	+ .01	+ .6	+ 4.5	104.9	62.1	267.5
	11 p. m. to 1 a. m	103.8	+ .04	+ 2.4	....	121.7	72.1	178.3
	Total, 6 hours	532.9	− .09	− 5.4	+13.5	324.3	192.0	733.0
	1 a. m. to 3 a. m	106.5	− .05	− 3.0	....	117.6	69.6	173.1
	3 a. m. to 5 a. m	95.5	− .07	− 4.2	....	111.3	65.9	157.2
	5 a. m. to 7 a. m	90.8	....	....	....	101.6	60.1	150.9
	Total, 6 hours	292.8	− .12	− 7.2	....	330.5	195.6	481.2
	Total, 1 day	4,455.5	− .10	− 6.0	−63.0	1,393.0	824.7	5,211.2
8–9	7 a. m. to 9 a. m	415.7	+ .28	+16.8	−18.4	115.7	68.5	482.6
	9 a. m. to 11 a. m	753.1	− .05	− 3.0	+ 3.2	131.9	78.1	831.4
	11 a. m. to 1 p. m	688.6	− .15	− 9.0	− 1.7	119.0	70.4	748.3
	Total, 6 hours	1,857.4	+ .08	+ 4.8	−16.9	366.6	217.0	2,062.3
	1 p. m. to 3 p. m	477.5	+ .08	+ 4.8	−30.0	124.2	73.5	525.8
	3 p. m. to 5 p. m	688.7	− .01	− .6	+ 2.6	119.7	70.9	761.6
	5 p. m. to 7 p. m	568.8	+ .02	+ 1.2	−33.0	122.5	72.5	609.5
	Total, 6 hours	1,735.0	+ .09	+ 5.4	−60.4	366.4	216.9	1,896.9
	7 p. m. to 9 p. m	224.7	− .12	− 7.2	+ 5.9	111.8	66.2	289.6
	9 p. m. to 11 p. m	198.3	+ .14	+ 8.4	+ 5.4	114.5	67.8	279.9
	11 p. m. to 1 a. m	107.4	− .04	− 2.4	....	127.6	75.5	180.5
	Total, 6 hours	530.4	− .02	− 1.2	+11.3	353.9	209.5	750.0
	1 a. m. to 3 a. m	91.4	− .08	− 4.8	....	112.5	66.6	153.2
	3 a. m. to 5 a. m	91.0	+ .06	+ 3.6	....	112.5	66.6	161.2
	5 a. m. to 7 a. m	91.7	− .02	− 1.2	....	91.1	53.9	144.4
	Total, 6 hours	274.1	− .04	− 2.4	....	316.1	187.1	458.8
	Total, 1 day	4,396.9	+ .11	+ 6.6	−66.0	1,403.0	830.5	5,168.0
9–10	7 a. m. to 9 a. m	461.5	+ .19	+11.4	−22.5	119.1	70.5	520.9
	9 a. m. to 11 a. m	765.4	+ .20	+12.0	+ 2.6	126.6	74.9	854.9
	11 a. m. to 1 p. m	673.2	− .31	−18.6	− 1.7	129.4	76.6	729.5
	Total, 6 hours	1,900.1	+ .08	+ 4.8	−21.6	375.1	222.0	2,105.3

TABLE 123.—*Summary of calorimetric measurements, etc.*—Continued.

Date.	Period.	(*a*) Heat measured in terms of C_{20}.	(*b*) Change of temperature of calorimeter.	(*c*) Capacity correction of calorimeter, $b\times 60$.	(*d*) Correction due to temperature of food and dishes.	(*e*) Water vaporized, equals total excess in outgoing air plus excess residual vapor.	(*f*) Heat rendered latent in vaporization of water, $e\times 0.592$.	(*g*) Total heat determined, $a+c+d+f$.
	Experiment No. 47—Continued.							
1901.		*Calories.*	*Degrees.*	*Cals.*	*Cals.*	*Grams.*	*Calories.*	*Calories.*
May 9–10......	1 p. m. to 3 p. m...	474.6	−0.01	−0.6	− 25.5	123.3	73.0	521.5
	3 p. m. to 5 p. m...	687.5	+ .11	+6.6	+ 1.6	131.1	77.6	773.3
	5 p. m. to 7 p. m...	555.8	− .09	−5.4	− 30.2	128.5	76.1	596.3
	Total, 6 hours	1,717.9	+ .01	+ .6	− 54.1	382.9	226.7	1,891.1
	7 p. m. to 9 p. m...	218.4	....	....	+ 8.2	112.5	66.6	293.2
	9 p. m. to 11 p. m..	215.7	− .01	− .6	+ 5.3	115.5	68.4	288.8
	11 p. m. to 1 a. m..	107.2	+ .01	+ .6	....	128.4	76.0	183.8
	Total, 6 hours	541.3	....	....	+ 13.5	356.4	211.0	765.8
	1 a. m. to 3 a. m...	103.1	....	....	....	112.4	66.5	169.6
	3 a. m. to 5 a. m...	92.6	− .01	− .6	....	116.4	68.9	160.9
	5 a. m. to 7 a. m...	88.9	− .12	−7.2	....	103.3	61.2	142.9
	Total, 6 hours	284.6	− .13	−7.8	....	332.1	196.6	473.4
	Total, 1 day..	4,443.9	− .04	−2.4	− 62.2	1,446.5	856.3	5,235.6
10–11......	7 a. m. to 9 a. m...	450.5	+ .11	+6.6	− 19.5	125.2	74.1	511.7
	9 a. m. to 11 a. m..	772.2	+ .10	+6.0	+ 1.8	131.1	77.6	857.6
	11 a. m. to 1 p. m..	672.0	− .06	−3.6	− 1.7	121.8	72.1	738.8
	Total, 6 hours	1,894.7	+ .15	+9.0	− 19.4	378.1	223.8	2,108.1
	1 p. m. to 3 p. m...	476.4	+ .03	+1.8	− 31.6	127.0	75.2	521.8
	3 p. m. to 5 p. m...	764.1	− .02	−1.2	+ 2.1	125.3	74.2	839.2
	5 p. m. to 7 p. m...	628.7	− .03	−1.8	− 33.8	132.3	78.3	671.4
	Total, 6 hours	1,869.2	− .02	−1.2	− 63.3	384.6	227.7	2,032.4
	7 p. m. to 9 p. m...	217.2	+ .01	+ .6	+ 8.4	113.5	67.2	293.4
	9 p. m. to 11 p. m..	219.7	− .03	−1.8	+ 4.9	118.2	70.0	292.8
	11 p. m. to 1 a. m..	96.2	+ .03	+1.8	....	127.0	75.2	173.2
	Total, 6 hours	533.1	+ .01	+ .6	+ 13.3	358.7	212.4	759.4
	1 a. m. to 3 a. m...	95.5	− .04	−2.4	....	125.6	74.4	167.5
	3 a. m. to 5 a. m...	88.6	+ .04	+2.4	....	119.1	70.5	161.5
	5 a. m. to 7 a. m...	84.6	− .01	− .6	....	110.2	65.2	149.2
	Total, 6 hours	268.7	− .01	− .6	....	354.9	210.1	478.2
	Total, 1 day..	4,565.7	+ .13	+7.8	− 69.4	1,476.3	874.0	5,378.1
	Total, 4 days.	17,862.0	+ .10	+6.0	−260.6	5,718.8	3,385.5	20,992.9
	Experiment No. 48.							
11–12......	7 a. m. to 9 a. m...	442.4	− .02	−1.2	− 28.3	113.0	66.9	479.8
	9 a. m. to 11 a. m..	722.5	+ .01	+ .6	+ 1.2	125.2	74.1	798.4
	11 a. m. to 1 p. m..	655.7	− .08	−4.8	− 1.7	131.2	77.7	726.9
	Total, 6 hours	1,820.6	− .09	−5.4	− 28.8	369.4	218.7	2,005.1
	1 p. m. to 3 p. m...	487.8	+ .03	+1.8	− 36.3	117.6	69.6	522.9
	3 p. m. to 5 p. m...	736.9	+ .04	+2.4	+ 1.2	126.3	74.8	815.3
	5 p. m. to 7 p. m...	514.4	+ .08	+4.8	− 31.0	132.0	78.1	566.3
	Total, 6 hours	1,739.1	+ .15	+9.0	− 66.1	375.9	222.5	1,904.5

TABLE 123.—*Summary of calorimetric measurements, etc.*—Continued.

Date.	Period.	(*a*) Heat measured in terms of C_{20}.	(*b*) Change of temperature of calorimeter.	(*c*) Capacity correction of calorimeter, $b \times 60$.	(*d*) Correction due to temperature of food and dishes.	(*e*) Water vaporized, equals total excess in outgoing air plus excess residual vapor.	(*f*) Heat rendered latent in vaporization of water, $e \times 0.592$.	(*g*) Total heat determined, $a+c+d+f$.
1901.	*Experiment No. 48*—Continued.	*Calories.*	*Degrees.*	*Cals.*	*Cals.*	*Grams.*	*Calories.*	*Calories.*
May 11-12.....	7 p. m. to 9 p. m...	220.9	−0.02	− 1.2	+ 5.5	120.9	71.6	296.8
	9 p. m. to 11 p. m..	230.2	+ .01	+ .6	+ 3.0	118.8	70.3	304.1
	11 p. m. to 1 a. m..	102.2	+ .02	+ 1.2	....	131.3	77.7	181.1
	Total, 6 hours	553.3	+ .01	+ .6	+ 8.5	371.0	219.6	782.0
	1 a. m. to 3 a. m...	120.5	− .06	− 3.6	....	131.2	77.7	194.6
	3 a. m. to 5 a. m...	108.4	+ .01	+ .6	....	130.9	77.5	186.5
	5 a. m. to 7 a. m...	84.4	− .08	− 4.8	....	110.9	65.7	145.3
	Total, 6 hours	313.3	− .13	− 7.8	....	373.0	220.9	526.4
	Total, 1 day .	4,426.3	− .06	− 3.6	−86.4	1,489.3	881.7	5,218.0
1902.	*Experiment No. 49.*							
Mar. 27-28.....	7 a. m. to 9 a. m...	503.1	+ .45	+27.0	−33.8	118.6	70.2	566.5
	9 a. m. to 11 a. m..	692.5	− .75	−45.0	+ 5.6	95.8	56.7	709.8
	11 a. m. to 1 p. m..	587.6	+ .24	+14.4	....	100.2	59.3	661.3
	Total, 6 hours	1,783.2	− .06	− 3.6	−28.2	314.6	186.2	1,937.6
	1 p. m. to 3 p. m...	526.5	+ .57	+34.2	−41.8	101.5	60.1	579.0
	3 p. m. to 5 p. m...	794.8	+ .15	+ 9.0	+ 5.8	113.0	66.9	876.5
	5 p. m. to 7 p. m...	737.6	− .45	−27.0	−42.1	110.7	65.5	734.0
	Total, 6 hours	2,058.9	+ .27	+16.2	−78.1	325.2	192.5	2,189.5
	7 p. m. to 9 p. m...	286.6	− .32	−19.2	....	118.7	70.3	337.7
	9 p. m. to 11 p. m..	240.0	+ .32	+19.2	+ 4.4	108.1	64.0	327.6
	11 p. m. to 1 a. m..	153.7	− .41	−24.6	+ 2.8	104.8	62.0	193.9
	Total, 6 hours	680.3	− .41	−24.6	+ 7.2	331.6	196.3	859.2
	1 a. m. to 3 a. m...	123.0	− .04	− 2.4	....	101.7	60.2	180.8
	3 a. m. to 5 a. m...	106.2	+ .03	+ 1.8	....	95.6	56.6	164.6
	5 a. m. to 7 a. m...	109.8	− .06	− 3.6	....	95.6	56.6	162.8
	Total, 6 hours	339.0	− .07	− 4.2	....	292.9	173.4	508.2
	Total, 1 day .	4,861.4	− .27	−16.2	−99.1	1,264.3	748.4	5,494.5
28-29.....	7 a. m. to 9 a. m...	461.1	+ .21	+12.6	−31.9	87.7	51.9	493.7
	9 a. m. to 11 a. m..	727.5	+1.29	+77.4	+ 4.9	112.3	66.5	876.3
	11 a. m. to 1 p. m..	613.2	−1.29	−77.4	....	95.9	56.8	592.6
	Total, 6 hours	1,801.8	+ .21	+12.6	−27.0	295.9	175.2	1,962.6
	1 p. m. to 3 p. m...	516.0	− .23	−13.8	−41.0	98.1	58.1	519.3
	3 p. m. to 5 p. m...	741.9	+ .11	+ 6.6	+ 4.9	102.3	60.5	813.9
	5 p. m. to 7 p. m...	560.1	....	....	−42.8	103.5	61.3	578.6
	Total, 6 hours	1,818.0	− .12	− 7.2	−78.9	303.9	179.9	1,911.8
	7 p. m. to 9 p. m...	248.9	− .04	− 2.4	....	104.8	62.1	308.6
	9 p. m. to 11 p. m..	222.9	+ .33	+19.8	+ 4.4	103.2	61.1	308.2
	11 p. m. to 1 a. m..	125.3	− .42	−25.2	+ 2.8	96.7	57.2	160.1
	Total, 6 hours	597.1	− .13	− 7.8	+ 7.2	304.7	180.4	776.9

TABLE 123.—*Summary of calorimetric measurements, etc.*—Continued.

Date.	Period.	(*a*) Heat measured in terms of C_{20}.	(*b*) Change of temperature of calorimeter.	(*c*) Capacity correction of calorimeter, $b \times 60$.	(*d*) Correction due to temperature of food and dishes.	(*e*) Water vaporized, equals total excess in outgoing air plus excess residual vapor.	(*f*) Heat rendered latent in vaporization of water, $e \times 0.592$.	(*g*) Total heat determined, $a+c+d+f$.
	Experiment No. 49—Continued.							
1902.		*Calories.*	*Degrees.*	*Cals.*	*Cals.*	*Grams.*	*Calories.*	*Calories.*
Mar. 28-29.....	1 a. m. to 3 a. m...	125.3	....	....	....	97.9	57.9	183.2
	3 a. m. to 5 a. m...	99.3	....	....	....	91.6	54.2	153.5
	5 a. m. to 7 a. m...	111.3	+0.20	+12.0	....	89.5	53.0	176.3
	Total, 6 hours	335.9	+ .20	+12.0	....	279.0	165.1	513.0
	Total, 1 day .	4,552.8	+ .16	+ 9.6	− 98.7	1,183.5	700.6	5,164.3
29-30.....	7 a. m. to 9 a. m...	444.3	+ .36	+21.6	− 33.2	86.4	51.1	483.8
	9 a. m. to 11 a. m..	641.4	− .57	−34.2	+ 4.6	84.1	49.8	661.6
	11 a. m. to 1 p. m..	563.4	− .24	−14.4	....	96.4	57.1	606.1
	Total, 6 hours	1,649.1	− .45	−27.0	− 28.6	266.9	158.0	1,751.5
	1 p. m. to 3 p. m...	462.4	+ .54	+32.4	− 41.3	88.1	52.2	505.7
	3 p. m. to 5 p. m...	686.7	+ .48	+28.8	+ 4.4	102.7	60.8	780.7
	5 p. m. to 7 p. m...	643.9	− .35	−21.0	− 43.3	99.7	59.0	638.6
	Total, 6 hours	1,793.0	+ .67	+40.2	− 80.2	290.5	172.0	1,925.0
	7 p. m. to 9 p. m...	289.3	− .19	−11.4	....	89.7	53.1	331.0
	9 p. m. to 11 p. m..	256.7	+ .09	+ 5.4	+ 4.4	98.2	58.1	324.6
	11 p. m. to 1 a. m..	136.8	− .18	−10.8	+ 2.8	106.6	63.1	191.9
	Total, 6 hours	682.8	− .28	−16.8	+ 7.2	294.5	174.3	847.5
	1 a. m. to 3 a. m...	129.8	....	....	....	102.5	60.7	190.5
	3 a. m. to 5 a. m...	123.1	− .06	− 3.6	....	102.7	60.8	180.3
	5 a. m. to 7 a. m...	121.0	+ .10	+ 6.0	....	92.6	54.8	181.8
	Total, 6 hours	373.9	+ .04	+ 2.4	....	297.8	176.3	552.6
	Total, 1 day .	4,498.8	− .02	− 1.2	−101.6	1,149.7	680.6	5,076.6
	Total, 3 days.	13,913.0	− .13	− 7.8	−299.4	3,597.5	2,129.6	15,735.4
	Experiment No. 50.							
Mar. 31-Apr. 1.	7 a. m. to 9 a. m...	446.2	+ .20	+12.0	− 42.4	88.3	52.3	468.1
	9 a. m. to 11 a. m..	682.6	+ .12	+ 7.2	− 2.5	105.7	62.6	749.9
	11 a. m. to 1 p. m..	660.0	− .33	−19.8	....	103.5	61.2	701.4
	Total, 6 hours	1,788.8	− .01	− .6	− 44.9	297.5	176.1	1,919.4
	1 p. m. to 3 p. m...	473.8	− .21	−12.6	− 63.4	93.7	55.5	453.3
	3 p. m. to 5 p. m...	273.6	+ .18	+10.8	+ 4.5	94.6	56.0	344.9
	5 p. m. to 7 p. m...	201.0	− .03	− 1.8	....	97.5	57.7	256.9
	Total, 6 hours	948.4	− .06	− 3.6	− 58.9	285.8	169.2	1,055.1
	7 p. m. to 9 p. m...	221.0	....	....	....	95.5	56.5	277.5
	9 p. m. to 11 p. m..	197.7	....	....	....	85.4	50.6	248.3
	11 p. m. to 1 a. m..	89.5	− .03	− 1.8	....	94.8	56.1	143.8
	Total, 6 hours	508.2	− .03	− 1.8	....	275.7	163.2	669.6

TABLE 123.—*Summary of calorimetric measurements, etc.*—Continued.

Date.	Period.	(*a*) Heat measured in terms of C_{20}.	(*b*) Change of temperature of calorimeter.	(*c*) Capacity correction of calorimeter, $b \times 60$.	(*d*) Correction due to temperature of food and dishes.	(*e*) Water vaporized, equals total excess in outgoing air plus excess residual vapor.	(*f*) Heat rendered latent in vaporization of water, $e \times 0.592$.	(*g*) Total heat determined, $a+c+d+f$.
1902.	*Experiment No. 50*—Continued.	*Calories.*	*Degrees.*	*Cals.*	*Cals.*	*Grams.*	*Calories.*	*Calories.*
Mar. 31–Apr. 1.	1 a. m. to 3 a. m.	114.4	−0.03	− 1.8	....	93.8	55.5	168.1
	3 a. m. to 5 a. m.	117.1	....	....	....	92.0	54.5	171.6
	5 a. m. to 7 a. m.	103.1	− .06	− 3.6	....	85.7	50.7	150.2
	Total, 6 hours	334.6	− .09	− 5.4	....	271.5	160.7	489.9
	Total, 1 day	3,580.0	− .19	−11.4	−103.8	1,130.5	669.2	4,134.0
	Experiment No. 51.							
Apr. 1–2	7 a. m. to 9 a. m.	210.6	+ .04	+ 2.4	+ 2.7	80.0	47.4	263.1
	9 a. m. to 11 a. m.	124.8	....	....	....	78.7	46.6	171.4
	11 a. m. to 1 p. m.	129.8	+ .18	+10.8	....	87.6	51.8	192.4
	Total, 6 hours	465.2	+ .22	+13.2	+ 2.7	246.3	145.8	626.9
	1 p. m. to 3 p. m.	155.7	− .18	−10.8	+ 2.6	79.8	47.2	194.7
	3 p. m. to 5 p. m.	143.9	− .04	− 2.4	....	85.4	50.6	192.1
	5 p. m. to 7 p. m.	151.5	+ .12	+ 7.2	+ 3.2	85.4	50.6	212.5
	Total, 6 hours	451.1	− .10	− 6.0	+ 5.8	250.6	148.4	599.3
	7 p. m. to 9 p. m.	176.5	+ .11	+ 6.6	....	97.3	57.6	240.7
	9 p. m. to 11 p. m.	157.1	+ .40	+24.0	....	90.2	53.4	234.5
	11 p. m. to 1 a. m.	154.3	− .48	−28.8	....	85.0	50.3	175.8
	Total, 6 hours	487.9	+ .03	+ 1.8	....	272.5	161.3	651.0
	1 a. m. to 3 a. m.	101.9	− .12	− 7.2	....	93.7	55.5	150.2
	3 a. m. to 5 a. m.	111.1	+ .12	+ 7.2	....	86.0	50.9	169.2
	5 a. m. to 7 a. m.	114.2	+ .04	+ 2.4	....	82.9	49.1	165.7
	Total, 6 hours	327.2	+ .04	+ 2.4	....	262.6	155.5	485.1
	Total, 1 day	1,731.4	+ .19	+11.4	+ 8.5	1,032.0	611.0	2,362.3
2–3	7 a. m. to 9 a. m.	222.8	− .13	− 7.8	+ 3.2	92.2	54.6	272.8
	9 a. m. to 11 a. m.	184.0	− .03	− 1.8	− .2	89.9	53.2	235.2
	11 a. m. to 1 p. m.	182.5	− .06	− 3.6	− 21.4	81.7	48.4	205.9
	Total, 6 hours	589.3	− .22	−13.2	− 18.4	263.8	156.2	713.9
	1 p. m. to 3 p. m.	174.6	....	....	....	70.3	41.6	216.2
	3 p. m. to 5 p. m.	152.4	− .03	− 1.8	− .1	76.3	45.2	195.7
	5 p. m. to 7 p. m.	155.1	+ .03	+ 1.8	− 19.0	84.1	49.8	187.7
	Total, 6 hours	482.1	....	....	− 19.1	230.7	136.6	599.6
	7 p. m. to 9 p. m.	154.0	+ .20	+12.0	....	81.9	48.5	214.5
	9 p. m. to 11 p. m.	154.7	+ .07	+ 4.2	....	75.2	44.5	203.4
	11 p. m. to 1 a. m.	113.4	− .03	− 1.8	....	81.1	48.0	159.6
	Total, 6 hours	422.1	+ .24	+14.4	....	238.2	141.0	577.5
	1 a. m. to 3 a. m.	116.4	− .15	− 9.0	....	77.2	45.7	153.1
	3 a. m. to 5 a. m.	108.5	− .09	− 5.4	....	74.7	44.2	147.3
	5 a. m. to 7 a. m.	108.4	....	....	....	81.7	48.4	156.8
	Total, 6 hours	333.3	− .24	−14.4	....	233.6	138.3	457.2
	Total, 1 day	1,826.8	− .22	−13.2	− 37.5	966.3	572.1	2,348.2
	Total, 2 days	3,558.2	− .03	− 1.8	− 29.0	1,998.3	1,183.1	4,710.5

TABLE 123.—*Summary of calorimetric measurements, etc.*—Continued.

Date.	Period.	(*a*) Heat measured in terms of C_{20}.	(*b*) Change of temperature of calorimeter.	(*c*) Capacity correction of calorimeter, $b\times60$.	(*d*) Correction due to temperature of food and dishes.	(*e*) Water vaporized, equals total excess in outgoing air plus excess residual vapor.	(*f*) Heat rendered latent in vaporization of water, $e\times0.592$.	(*g*) Total heat determined, $a+c+d+f$.
1902.	*Experiment No. 52.*	*Calories.*	*Degrees.*	*Cals.*	*Cals.*	*Grams.*	*Calories.*	*Calories.*
Apr. 21–22.....	7 a. m. to 9 a. m...	404.6	−0.12	− 7.2	−14.3	93.5	55.4	438.5
	9 a. m. to 11 a. m..	648.2	+ .23	+13.8	+ 2.4	110.4	65.4	729.8
	11 a. m. to 1 p. m..	627.2	− .23	−13.8	....	106.3	62.9	676.3
	Total, 6 hours	1,680.0	− .12	− 7.2	−11.9	310.2	183.7	1,844.6
	1 p. m. to 3 p. m...	529.8	+ .15	+ 9.0	−18.0	102.8	60.9	581.7
	3 p. m. to 5 p. m...	853.9	+ .02	+ 1.2	+ 1.7	112.7	66.7	923.5
	5 p. m. to 7 p. m...	709.5	+ .18	+10.8	+15.6	113.7	67.3	772.0
	Total, 6 hours	2,093.2	+ .35	+21.0	−31.9	329.2	194.9	2,277.2
	7 p. m. to 9 p. m...	262.2	+ .02	+ 1.2	− .1	107.2	63.5	326.8
	9 p. m. to 11 p. m..	249.6	− .38	−22.8	+ 3.0	100.8	59.7	289.5
	11 p. m. to 1 a. m..	150.2	− .12	− 7.2	....	110.7	65.5	208.5
	Total, 6 hours	662.0	− .48	−28.8	+ 2.9	318.7	188.7	824.8
	1 a. m. to 3 a. m...	133.4	+ .08	+ 4.8	....	96.5	57.1	195.3
	3 a. m. to 5 a. m...	118.3	− .12	− 7.2	....	90.3	53.5	164.6
	5 a. m. to 7 a. m...	97.6	+ .17	+10.2	....	93.8	55.5	163.3
	Total, 6 hours	349.3	+ .13	+ 7.8	....	280.6	166.1	523.2
	Total, 1 day..	4,784.5	− .12	− 7.2	−40.9	1,238.7	733.4	5,469.8
22–23.....	7 a. m. to 9 a. m...	426.3	+ .07	+ 4.2	− 9.7	97.2	57.5	478.3
	9 a. m. to 11 a. m..	698.8	+ .08	+ 4.8	+ 2.4	116.7	69.1	775.1
	11 a. m. to 1 p. m..	651.8	− .28	−16.8	− .3	114.5	67.8	702.5
	Total, 6 hours	1,776.9	− .13	− 7.8	− 7.6	328.4	194.4	1,955.9
	1 p. m. to 3 p. m...	464.2	+ .15	+ 9.0	−17.4	94.3	55.8	511.6
	3 p. m. to 5 p. m...	720.8	− .03	− 1.8	+ 2.1	116.7	69.1	790.2
	5 p. m. to 7 p. m...	553.9	+ .12	+ 7.2	−16.6	103.5	61.3	605.8
	Total, 6 hours	1,738.9	+ .24	+14.4	−31.9	314.5	186.2	1,907.6
	7 p. m. to 9 p. m...	246.8	− .05	− 3.0	....	107.9	63.9	307.7
	9 p. m. to 11 p. m..	218.6	− .07	− 4.2	+ 2.5	102.1	60.4	277.3
	11 p. m. to 1 a. m..	137.1	− .02	− 1.2	....	102.3	60.6	196.5
	Total, 6 hours	602.5	− .14	− 8.4	+ 2.5	312.3	184.9	781.5
	1 a. m. to 3 a. m...	133.8	....	....	....	104.2	61.7	195.5
	3 a. m. to 5 a. m...	118.2	− .17	−10.2	....	87.5	51.8	159.8
	5 a. m. to 7 a. m...	95.2	+ .18	+10.8	....	90.1	53.3	159.3
	Total, 6 hours	347.2	+ .01	+ .6	....	281.8	166.8	514.6
	Total, 1 day..	4,465.5	− .02	− 1.2	−37.0	1,237.0	732.3	5,159.6
23–24.....	7 a. m. to 9 a. m...	422.6	− .07	− 4.2	− 3.1	91.5	54.2	469.5
	9 a. m. to 11 a. m..	679.5	+ .45	+27.0	+ 2.5	115.7	68.5	777.5
	11 a. m. to 1 p. m..	659.6	− .33	−19.8	− .3	107.6	63.7	703.2
	Total, 6 hours	1,761.7	+ .05	+ 3.0	− .9	314.8	186.4	1,950.2

TABLE 123.—*Summary of calorimetric measurements, etc.*—Continued.

Date.	Period.	(*a*) Heat measured in terms of C_{20}.	(*b*) Change of temperature of calorimeter.	(*c*) Capacity correction of calorimeter, $b \times 60$.	(*d*) Correction due to temperature of food and dishes.	(*e*) Water vaporized, equals total excess in outgoing air plus excess residual vapor.	(*f*) Heat rendered latent in vaporization of water, $e \times 0.592$.	(*g*) Total heat determined, $a+c+d+f$.
1902.	*Experiment No. 52*—Continued.	*Calories.*	*Degrees.*	*Cals.*	*Cals.*	*Grams.*	*Calories.*	*Calories.*
Apr. 23–24.....	1 p. m. to 3 p. m...	424.2	+0.87	+52.2	− 17.8	112.0	66.3	524.9
	3 p. m. to 5 p. m...	779.3	− .80	−48.0	+ 2.7	95.9	56.8	790.8
	5 p. m. to 7 p. m...	608.3	− .10	− 6.0	− 12.4	109.5	64.8	654.7
	Total, 6 hours	1,811.8	− .03	− 1.8	− 27.5	317.4	187.9	1,970.4
	7 p. m. to 9 p. m...	233.8	+ .05	+ 3.0	+ 3.0	101.5	60.1	299.9
	9 p. m. to 11 p. m..	217.7	− .05	− 3.0	....	98.3	58.2	272.9
	11 p. m. to 1 a. m..	134.0	+ .05	+ 3.0	....	107.6	63.7	200.7
	Total, 6 hours	585.5	+ .05	+ 3.0	+ 3.0	307.4	182.0	773.5
	1 a. m. to 3 a. m...	135.1	− .20	−12.0	....	97.4	57.7	180.8
	3 a. m. to 5 a. m...	113.2	+ .10	+ 6.0	....	98.8	58.5	177.7
	5 a. m. to 7 a. m...	97.2	− .10	− 6.0	....	99.5	58.9	150.1
	Total, 6 hours	345.5	− .20	−12.0	....	295.7	175.1	508.6
	Total, 1 day..	4,504.5	− .13	− 7.8	− 25.4	1,235.3	731.4	5,202.7
	Total, 3 days.	13,754.5	− .27	−16.2	−103.3	3,711.0	2,197.1	15,832.1
	Experiment No. 53.							
24–25.....	7 a. m. to 9 a. m...	405.3	+ .33	+19.8	− 13.4	93.2	55.2	466.9
	9 a. m. to 11 a. m..	697.9	− .28	−16.8	+ 2.7	83.6	49.5	733.3
	11 a. m. to 1 p. m..	687.5	−1.03	−61.8	....	100.2	59.3	685.0
	Total, 6 hours	1,790.7	− .98	−58.8	− 10.7	277.0	164.0	1,885.2
	1 p. m. to 3 p. m...	415.2	+1.08	+64.8	− 19.0	91.2	54.0	515.0
	3 p. m. to 5 p. m...	678.6	+ .12	+ 7.2	+ 2.2	106.0	62.8	750.8
	5 p. m. to 7 p. m...	591.0	− .08	− 4.8	− 20.1	105.8	62.6	628.7
	Total, 6 hours	1,684.8	+1.12	+67.2	− 36.9	303.0	179.4	1,894.5
	7 p. m. to 9 p. m...	226.5	+ .10	+ 6.0	....	92.1	54.5	287.0
	9 p. m. to 11 p. m..	226.2	+ .02	+ 1.2	+ 2.9	93.8	55.5	285.8
	11 p. m. to 1 a. m..	132.1	− .13	− 7.8	....	116.7	69.1	193.4
	Total, 6 hours	584.8	− .01	− .6	+ 2.9	302.6	179.1	766.2
	1 a. m. to 3 a. m...	116.0	− .12	− 7.2	....	103.6	61.3	170.1
	3 a. m. to 5 a. m...	85.6	+ .10	+ 6.0	....	106.2	62.9	154.5
	5 a. m. to 7 a. m...	99.0	+ .03	+ 1.8	....	96.7	57.3	158.1
	Total, 6 hours	300.6	+ .01	+ .6	....	306.5	181.5	482.7
	Total, 1 day..	4,360.9	+ .14	+ 8.4	− 44.7	1,189.1	704.0	5,028.6
25–26.....	7 a. m. to 9 a. m...	409.9	+ .28	+16.8	− 16.8	92.7	54.8	464.7
	9 a. m. to 11 a. m..	752.2	− .08	− 4.8	+ 2.1	109.5	64.8	814.3
	11 a. m. to 1 p. m..	651.3	− .55	−33.0	....	87.1	51.6	669.9
	Total, 6 hours	1,813.4	− .35	−21.0	− 14.7	289.3	171.2	1,948.9
	1 p. m. to 3 p. m...	458.4	+ .53	+31.8	− 19.3	101.2	59.9	530.8
	3 p. m. to 5 p. m...	753.3	+ .05	+ 3.0	+ 2.8	112.8	66.8	825.9
	5 p. m. to 7 p. m...	617.8	− .17	−10.2	− 18.0	108.0	63.9	653.5
	Total, 6 hours	1,829.5	+ .41	+24.6	− 34.5	322.0	190.6	2,010.2

TABLE 123.—*Summary of calorimetric measurements, etc.*—Continued.

Date.	Period.	(a) Heat measured in terms of C_{20}.	(b) Change of temperature of calorimeter.	(c) Capacity correction of calorimeter, $b\times 60$.	(d) Correction due to temperature of food and dishes.	(e) Water vaporized, equals total excess in outgoing air plus excess residual vapor.	(f) Heat rendered latent in vaporization of water, $e\times 0.592$.	(g) Total heat determined, $a+c+d+f$.
	Experiment No. 53—Continued.							
1902.		*Calories.*	*Degrees.*	*Cals.*	*Cals.*	*Grams.*	*Calories.*	*Calories.*
Apr. 25–26.....	7 p. m. to 9 p. m...	226.1	+0.05	+ 3.0	....	95.5	56.5	285.6
	9 p. m. to 11 p. m..	206.2	....	....	+ 3.0	103.1	61.1	270.3
	11 p. m. to 1 a. m..	137.4	− .13	− 7.8	....	111.0	65.7	195.3
	Total, 6 hours	569.7	− .08	− 4.8	+ 3.0	309.6	183.3	751.2
	1 a. m. to 3 a. m...	105.8	....	....	....	95.5	56.5	162.3
	3 a. m. to 5 a. m...	102.3	− .10	− 6.0	....	97.5	57.7	154.0
	5 a. m. to 7 a. m...	110.9	+ .15	+ 9.0	....	85.7	50.8	170.7
	Total, 6 hours	319.0	+ .05	+ 3.0	....	278.7	165.0	487.0
	Total, 1 day..	4,531.6	+ .03	+ 1.8	− 46.2	1,199.6	710.1	5,197.3
26–27.....	7 a. m. to 9 a. m...	428.3	+ .03	+ 1.8	− 15.6	90.9	53.8	468.3
	9 a. m. to 11 a. m..	787.1	+ .02	+ 1.2	+ 1.4	110.3	65.3	855.0
	11 a. m. to 1 p. m..	653.4	− .20	−12.0	....	111.6	66.1	707.5
	Total, 6 hours	1,868.8	− .15	− 9.0	− 14.2	312.8	185.2	2,030.8
	1 p. m. to 3 p. m...	508.2	+ .23	+13.8	− 23.3	100.9	59.7	558.4
	3 p. m. to 5 p. m...	773.3	+ .05	+ 3.0	+ 2.6	107.5	63.6	842.5
	5 p. m. to 7 p. m...	547.7	− .02	− 1.2	− 22.9	103.3	61.2	584.8
	Total, 6 hours	1,829.2	+ .26	+15.6	− 43.6	311.7	184.5	1,985.7
	7 p. m. to 9 p. m...	240.5	− .13	− 7.8	....	97.8	57.9	290.6
	9 p. m. to 11 p. m..	214.0	+ .10	+ 6.0	+ 2.9	101.4	60.0	282.9
	11 p. m. to 1 a. m..	134.6	− .05	− 3.0	....	102.7	60.8	192.4
	Total, 6 hours	589.1	− .08	− 4.8	+ 2.9	301.9	178.7	765.9
	1 a. m. to 3 a. m...	118.2	− .10	− 6.0	....	95.0	56.2	168.4
	3 a. m. to 5 a. m...	120.5	+ .12	+ 7.2	....	99.4	58.9	186.6
	5 a. m. to 7 a. m...	126.7	− .12	− 7.2	....	86.1	51.0	170.5
	Total, 6 hours	365.4	− .10	− 6.0	....	280.5	166.1	525.5
	Total, 1 day..	4,652.5	− .07	− 4.2	− 54.9	1,206.9	714.5	5,307.9
	Total, 3 days.	13,545.0	+ .10	+ 6.0	−145.8	3,595.6	2,128.6	15,533.8
	Experiment No. 54.							
27–28.....	7 a. m. to 9 a. m...	416.4	+ .27	+16.2	− 20.2	87.6	51.9	464.3
	9 a. m. to 11 a. m..	739.9	− .28	−16.8	+ 2.1	101.1	59.9	785.1
	11 a. m. to 1 p. m..	633.4	− .68	−40.8	....	90.1	53.3	645.9
	Total, 6 hours	1,789.7	− .69	−41.4	− 18.1	278.8	165.1	1,895.3
	1 p. m. to 3 p. m...	458.3	+ .77	+46.2	− 21.7	89.9	53.2	536.0
	3 p. m. to 5 p. m...	739.7	+ .13	+ 7.8	+ 1.9	107.6	63.7	813.1
	5 p. m. to 7 p. m...	611.7	− .10	− 6.0	− 17.6	96.7	57.3	645.4
	Total, 6 hours	1,809.7	+ .80	+48.0	− 37.4	294.2	174.2	1,994.5
	7 p. m. to 9 p. m...	234.2	+ .05	+ 3.0	+ 2.7	89.0	52.7	292.6
	9 p. m. to 11 p. m..	228.0	− .12	− 7.2	....	103.4	61.2	282.0
	11 p. m. to 1 a. m..	127.4	+ .07	+ 4.2	....	105.3	62.3	193.9
	Total, 6 hours	589.6	....	....	+ 2.7	297.7	176.2	768.5

TABLE 123.—*Summary of calorimetric measurements, etc.*—Continued.

Date.	Period.	(*a*) Heat measured in terms of C_{20}.	(*b*) Change of temperature of calorimeter.	(*c*) Capacity correction of calorimeter, $b \times 60$.	(*d*) Correction due to temperature of food and dishes.	(*e*) Water vaporized, equals total excess in outgoing air plus excess residual vapor.	(*f*) Heat rendered latent in vaporization of water, $e \times 0.592$.	(*g*) Total heat determined, $a+c+d+f$.
	Experiment No. 54—Continued.							
1902.		*Calories.*	*Degrees.*	*Cals.*	*Cals.*	*Grams.*	*Calories.*	*Calories.*
Apr. 27–28.....	1 a. m. to 3 a. m...	128.0	−0.12	− 7.2	....	112.4	66.5	187.3
	3 a. m. to 5 a. m...	111.5	− .03	− 1.8	....	95.4	56.5	166.2
	5 a. m. to 7 a. m...	113.6	− .02	− 1.2	....	87.9	52.0	164.4
	Total, 6 hours	353.1	− .17	−10.2	....	295.7	175.0	517.9
	Total, 1 day..	4,542.1	− .06	− 3.6	− 52.8	1,166.4	690.5	5,176.2
28–29.....	7 a. m. to 9 a. m...	452.2	+ .50	+30.0	− 15.3	109.6	64.9	531.8
	9 a. m. to 11 a. m..	809.1	− .50	−30.0	+ 2.0	103.8	61.5	842.6
	11 a. m. to 1 p. m..	696.2	− .93	−55.8	....	78.1	46.2	686.6
	Total, 6 hours	1,957.5	− .93	−55.8	− 13.3	291.5	172.6	2,061.0
	1 p. m. to 3 p. m...	442.6	+1.17	+70.2	− 18.6	120.0	71.0	565.2
	3 p. m. to 5 p. m...	811.4	+ .17	+10.2	+ 1.6	80.7	47.8	871.0
	5 p. m. to 7 p. m...	483.3	− .33	−19.8	− 18.6	71.3	42.2	487.1
	Total, 6 hours	1,737.3	+1.01	+60.6	− 35.6	272.0	161.0	1,923.3
	7 p. m. to 9 p. m...	240.9	− .08	− 4.8	....	94.8	56.1	292.2
	9 p. m. to 11 p. m..	220.0	− .07	− 4.2	+ 2.9	90.5	53.6	272.3
	11 p. m. to 1 a. m..	127.6	+ .08	+ 4.8	....	98.4	58.3	190.7
	Total, 6 hours	588.5	− .07	− 4.2	+ 2.9	283.7	168.0	755.2
	1 a. m. to 3 a. m...	123.1	− .08	− 4.8	....	98.4	58.2	176.5
	3 a. m. to 5 a. m...	116.8	+ .17	+10.2	....	97.5	57.7	184.7
	5 a. m. to 7 a. m...	102.7	− .03	− 1.8	....	86.6	51.3	152.2
	Total, 6 hours	342.6	+ .06	+ 3.6	....	282.5	167.2	513.4
	Total, 1 day..	4,625.9	+ .07	+ 4.2	− 46.0	1,129.7	668.8	5,252.9
29–30.....	7 a. m. to 9 a. m...	458.4	+ .40	+24.0	− 14.8	94.5	55.9	523.5
	9 a. m. to 11 a. m..	797.1	− .27	−16.2	+ 1.9	97.9	58.0	840.8
	11 a. m. to 1 p. m..	699.4	− .38	−22.8	....	112.2	66.4	743.0
	Total, 6 hours	1,954.9	− .25	−15.0	− 12.9	304.6	180.3	2,107.3
	1 p. m. to 3 p. m...	484.9	+ .30	+18.0	− 20.7	99.6	59.0	541.2
	3 p. m. to 5 p. m...	654.4	+ .48	+28.8	+ 1.1	102.1	60.4	744.7
	5 p. m. to 7 p. m...	550.2	− .37	−22.2	− 16.6	115.3	68.3	579.7
	Total, 6 hours	1,689.5	+ .41	+24.6	− 36.2	317.0	187.7	1,865.6
	7 p. m. to 9 p. m...	207.8	+ .18	+10.8	....	115.2	68.2	286.8
	9 p. m. to 11 p. m..	201.9	− .02	− 1.2	+ 2.2	99.9	59.1	262.0
	11 p. m. to 1 a. m..	125.9	− .07	− 4.2	....	102.0	60.4	182.1
	Total, 6 hours	535.6	+ .09	+ 5.4	+ 2.2	317.1	187.7	730.9
	1 a. m. to 3 a. m...	118.6	− .13	− 7.8	....	107.2	63.5	174.3
	3 a. m. to 5 a. m...	110.0	+ .07	+ 4.2	....	105.5	62.5	176.7
	5 a. m. to 7 a. m...	107.2	+ .02	+ 1.2	....	88.6	52.4	160.8
	Total, 6 hours	335.8	− .04	− 2.4	....	301.3	178.4	511.8
	Total, 1 day..	4,515.8	+ .21	+12.6	− 46.9	1,240.0	734.1	5,215.6
	Total, 3 days.	13,683.8	+ .22	+13.2	−145.7	3,536.1	2,093.4	15,644.7

TABLE 123.—*Summary of calorimetric measurements, etc.*—Continued.

Date.	Period.	(*a*) Heat measured in terms of C_{20}.	(*b*) Change of temperature of calorimeter.	(*c*) Capacity correction of calorimeter, $b \times 60$.	(*d*) Correction due to temperature of food and dishes.	(*e*) Water vaporized, equals total excess in outgoing air plus excess residual vapor.	(*f*) Heat rendered latent in vaporization of water, $e \times 0.592$.	(*g*) Total heat determined, $a+c+d+f$.
1902.	*Experiment No. 55.*	*Calories.*	*Degrees.*	*Cals.*	*Cals.*	*Grams.*	*Calories.*	*Calories.*
Apr. 30–May 1..	7 a. m. to 9 a. m...	612.0	+0.45	+27.0	−15.6	121.4	71.9	695.3
	9 a. m. to 11 a. m..	931.4	− .32	−19.2	+ 1.7	116.6	69.0	982.9
	11 a. m. to 1 p. m..	878.8	+ .12	+ 7.2	....	133.8	79.2	965.2
	Total, 6 hours	2,422.2	+ .25	+15.0	−13.9	371.8	220.1	2,643.4
	1 p. m. to 3 p. m...	650.7	− .12	− 7.2	−18.6	126.9	75.1	700.0
	3 p. m. to 5 p. m...	925.1	+ .12	+ 7.2	+ 1.5	121.4	71.9	1,005.7
	5 p. m. to 7 p. m...	727.5	− .20	−12.0	−18.0	138.3	81.9	779.4
	Total, 6 hours	2,303.3	− .20	−12.0	−35.1	386.6	228.9	2,485.1
	7 p. m. to 9 p. m...	674.7	+ .15	+ 9.0	+ 2.4	127.7	75.6	761.7
	9 p. m. to 11 p. m..	889.3	− .20	−12.0	+ 2.9	131.7	77.9	958.1
	11 p. m. to 1 a. m..	829.6	− .03	− 1.8	−16.4	112.5	66.6	878.0
	Total, 6 hours	2,393.6	− .08	− 4.8	−11.1	371.9	220.1	2,597.8
	1 a. m. to 3 a. m...	113.2	+ .02	+ 1.2	+ 3.5	122.2	72.4	190.3
	3 a. m. to 5 a. m...	447.1	+ .12	+ 7.2	....	130.8	77.4	531.7
	5 a. m. to 7 a. m...	807.0	− .18	−10.8	+ 2.2	113.2	67.0	865.4
	Total, 6 hours	1,367.3	− .04	− 2.4	+ 5.7	366.2	216.8	1,587.4
	Total, 1 day..	8,486.4	− .07	− 4.2	−54.4	1,496.5	885.9	9,313.7

TABLE 124.—*Total heat eliminated in 2-hour periods, metabolism experiments Nos. 35–55, inclusive.*

Kind and number of experiment.	Day.	7 a. m. to 9 a. m.	9 a. m. to 11 a. m.	11 a. m. to 1 p. m.	Total, 6 hours.	1 p. m. to 3 p. m.	3 p. m. to 5 p. m.	5 p. m. to 7 p. m.	Total, 6 hours.	7 p. m. to 9 p. m.	9 p. m. to 11 p. m.	11 p. m. to 1 a. m.	Total, 6 hours.	1 a. m. to 3 a. m.	3 a. m. to 5 a. m.	5 a. m. to 7 a. m.	Total, 6 hours.	Total, 1 day.
Restexperiment, without food.		*Cals.*	*Cals.*	*Cals.*	*Cals.*	*Cals.*	*Cals.*	*Cals.*	*Cals.*	*Cals.*	*Cals.*	*Cals.*	*Cals.*	*Cals.*	*Cals.*	*Cals.*	*Cals.*	*Cals.*
No. 36	1	237.5	216.9	202.5	656.9	212.7	199.3	198.9	610.9	202.3	193.1	131.5	526.9	131.6	149.3	177.2	458.1	2,252.8
No. 39	1	218.8	199.2	163.3	581.3	186.7	161.6	169.0	517.3	143.1	159.6	164.7	467.4	160.6	127.7	172.6	460.9	2,026.9
No. 42	1	225.9	147.7	148.1	521.7	163.1	158.1	166.4	487.6	160.0	181.5	137.7	479.2	146.8	144.2	166.6	457.6	1,946.1
No. 51	1	263.1	171.4	192.4	626.9	194.7	192.1	212.5	599.3	240.7	234.5	175.8	651.0	150.2	169.2	165.7	485.1	2,362.3
No. 51	2	272.8	235.2	205.9	713.9	216.2	195.7	187.7	599.6	214.5	203.4	159.6	577.5	153.1	147.3	156.8	457.2	2,348.2
Average per day	......	268.0	203.3	199.1	670.4	205.4	193.9	200.1	599.4	227.6	219.0	167.7	614.3	151.7	158.3	161.2	471.2	2,355.3
Average Nos. 36, 39, 42, and 51	......	243.6	194.1	182.4	620.1	194.7	181.4	186.9	563.0	192.1	194.4	153.9	540.4	148.5	147.5	167.8	463.8	2,187.3
Rest experiment, with food.																		
No. 35	1	267.4	247.5	218.2	733.1	235.0	229.4	215.8	680.2	234.4	222.8	137.6	594.8	144.8	123.0	138.0	405.8	2,413.9
No. 35	2	253.5	225.4	207.8	686.7	236.2	224.6	209.7	670.5	208.1	200.4	*a* 156.4	564.9	171.9	140.9	151.4	464.2	2,386.3
No. 35	3	245.8	229.6	198.4	673.8	228.2	220.2	227.7	676.1	231.3	228.2	154.8	614.3	142.0	143.2	163.5	418.7	2,412.9
No. 35	4	246.8	229.2	216.7	692.7	225.7	225.1	214.1	664.9	205.2	200.8	*a* 131.9	537.9	160.7	154.7	163.9	479.3	2,374.8
Average per day	......	253.4	232.9	210.3	696.6	231.3	224.8	216.8	672.9	219.8	213.0	145.2	578.0	154.9	140.4	154.2	449.5	2,397.0
Work experiments, conditions exceptional.																		
No. 50	1	468.1	749.9	701.4	1,919.4	453.3	*b* 344.9	256.9	1,055.1	277.5	248.3	143.8	669.6	168.1	171.6	150.2	489.9	4,134.0
No. 55	1	695.3	982.9	965.2	2,643.4	700.0	1,005.7	779.4	2,485.1	761.7	958.1	878.0	2,597.8	*c* 190.3	531.7	865.4	1,587.4	9,313.7
Work experiments, carbohydrate diet.																		
No. 37	1	463.5	630.1	543.2	1,636.8	442.5	677.8	623.1	1,743.4	298.1	289.9	153.7	741.7	174.8	155.5	174.9	505.2	4,627.1
No. 37	2	476.0	736.5	728.7	1,941.2	559.4	773.3	621.5	1,954.2	291.5	274.9	134.5	700.9	167.9	123.1	147.8	438.8	5,035.1
No. 37	3	503.3	752.0	694.5	1,949.8	490.7	788.5	575.5	1,854.7	259.9	262.6	138.6	661.1	162.0	159.4	149.9	471.3	4,936.9
No. 37	4	437.9	676.8	582.1	1,696.8	489.2	660.7	536.3	1,686.2	258.0	250.0	139.1	647.1	147.7	137.1	142.6	427.4	4,457.5
Average per day	......	470.2	698.9	637.1	1,806.2	495.4	725.1	589.1	1,809.6	276.9	269.3	141.5	687.7	163.1	143.8	153.8	460.7	4,764.2

No. 40	1	521.6	839.4	759.2	2,120.2	619.9	814.2	650.2	2,084.3	288.7	269.2	173.8	731.7	158.8	147.3	174.7	480.8	5,417.0
No. 40	2	462.9	767.7	715.3	1,945.9	552.6	818.0	636.7	2,007.3	291.1	220.6	164.0	675.7	161.8	159.4	162.3	483.5	5,112.4
No. 40	3	484.9	836.4	705.6	2,026.9	528.1	785.1	647.2	1,960.4	282.9	259.2	166.5	708.6	170.7	148.9	155.6	475.2	5,171.1
No. 40	4	481.0	796.6	704.2	1,981.8	522.2	809.3	698.1	2,029.6	263.9	256.8	165.6	686.3	158.4	152.6	182.9	493.9	5,191.6
Average per day	......	487.6	810.0	721.1	2,018.7	555.7	806.6	658.1	2,020.4	281.7	251.4	167.5	700.6	162.4	152.0	168.9	483.3	5,223.0
No. 44	1	511.2	736.0	664.6	1,911.8	517.1	765.7	763.2	2,046.0	306.5	270.8	183.8	761.1	168.0	153.3	168.3	489.6	5,208.5
No. 44	2	430.8	737.0	669.7	1,837.5	532.5	811.0	667.3	2,010.8	292.3	267.9	163.1	723.3	148.0	162.5	171.4	481.9	5,053.5
No. 44	3	473.7	745.6	631.0	1,850.3	577.7	827.0	655.8	2,060.5	294.2	277.8	170.5	742.5	152.9	158.3	151.0	462.2	5,115.5
No. 44	4	483.7	843.1	752.4	2,079.2	552.2	820.4	708.7	2,081.3	288.6	286.9	160.9	736.4	189.0	155.9	175.0	519.9	5,416.8
Average per day	......	474.9	765.4	679.4	1,919.7	544.9	806.0	698.8	2,049.7	295.4	275.8	169.6	740.8	164.5	157.5	166.4	488.4	5,198.6
No. 47	1	488.1	827.4	737.2	2,052.7	536.3	782.9	625.1	1,944.3	287.2	267.5	178.3	733.0	173.1	157.2	150.9	481.2	5,211.2
No. 47	2	482.6	831.4	748.3	2,062.3	525.8	761.6	609.5	1,896.9	289.6	279.9	180.5	750.0	153.2	161.2	144.4	458.8	5,168.0
No. 47	3	520.9	854.9	729.5	2,105.3	521.5	773.3	596.3	1,891.1	293.2	288.8	183.8	765.8	169.6	160.9	142.9	473.4	5,235.6
No. 47	4	511.7	857.6	738.8	2,108.1	521.8	839.2	671.4	2,032.4	293.4	292.8	173.2	759.4	167.5	161.5	149.2	478.2	5,378.1
Average per day	......	500.8	842.8	738.5	2,082.1	526.3	789.3	625.6	1,941.2	290.9	282.2	178.9	752.0	165.9	160.2	146.8	472.9	5,248.2
No. 49	1	566.5	709.8	661.3	1,937.6	579.0	876.5	734.0	2,189.5	337.7	327.6	193.9	859.2	180.8	164.6	162.8	508.2	5,494.5
No. 49	2	493.7	876.3	592.6	1,962.6	519.3	813.9	578.6	1,911.8	308.6	308.2	160.1	776.9	183.2	153.5	176.3	513.0	5,164.3
No. 49	3	483.8	661.6	606.1	1,751.5	505.7	780.7	638.6	1,925.0	331.0	324.6	191.9	847.5	190.5	180.3	181.8	552.6	5,076.6
Average per day	......	514.7	749.2	620.0	1,883.9	534.7	823.7	650.4	2,008.8	325.8	320.1	182.0	827.9	184.9	166.1	173.6	524.6	5,245.2
No. 53	1	466.9	733.3	685.0	1,885.2	515.0	750.8	628.7	1,894.5	287.0	285.8	193.4	766.2	170.1	154.5	158.1	482.7	5,028.6
No. 53	2	464.7	814.3	669.9	1,948.9	530.8	825.9	653.5	2,010.2	285.6	270.3	195.3	751.2	162.3	154.0	170.7	487.0	5,197.3
No. 53	3	468.3	855.0	707.5	2,030.8	558.4	842.5	584.8	1,985.7	290.6	282.9	192.4	765.9	168.4	186.6	170.5	525.5	5,307.9
Average per day	......	466.6	800.9	687.5	1,955.0	534.7	806.4	622.3	1,963.4	287.7	279.7	193.7	761.1	167.0	165.0	166.4	498.4	5,177.9
Average Nos. 37, 40, 44, and 47	......	483.4	779.3	694.0	1,956.7	530.6	781.8	642.8	1,955.2	286.2	269.7	164.4	720.3	164.0	153.3	159.0	476.3	5,108.5
Average Nos. 49 and 53	......	490.7	775.1	653.7	1,919.5	534.7	815.1	636.3	1,986.1	306.8	299.9	187.8	794.5	176.0	165.5	170.0	511.5	5,211.6
Average Nos. 31, 40, 44, 47, 49, and 53	......	485.4	778.1	683.0	1,946.5	531.7	790.9	641.1	1,963.7	291.8	278.0	170.7	740.5	167.2	156.7	162.0	485.9	5,136.6

[a] On these nights the supper was eaten at 10.45 p. m.

[b] In this experiment the subject stopped work at 3 p. m.

[c] In this experiment the subject was off the bicycle from 1 a. m. to 4.13 a. m.

TABLE 124.—*Total heat eliminated in 2-hour periods, metabolism experiments Nos. 35–55, inclusive*—Continued.

Kind and number of experiment.	Day.	7 a. m. to 9 a. m.	9 a. m. to 11 a. m.	11 a. m to 1 p. m.	Total, 6 hours.	1 p. m. to 3 p. m.	3 p. m. to 5 p. m.	5 p. m. to 7 p. m.	Total, 6 hours.	7 p. m. to 9 p. m.	9 p. m. to 11 p. m.	11 p. m. to 1 a. m.	Total 6 hours.	1 a. m. to 3 a. m.	3 a. m. to 5 a. m.	5 a. m. to 7 a. m.	Total, 6 hours.	Total, 1 day.
Work experiment, fat diet.		*Cals.*	*Cals.*	*Cals.*	*Cals.*	*Cals.*	*Cals.*	*Cals.*	*Cals.*	*Cals.*	*Cals.*	*Cals.*	*Cals.*	*Cals.*	*Cals.*	*Cals.*	*Cals.*	*Cals.*
No. 38	1	415.2	652.0	600.2	1,667.4	491.0	674.5	561.4	1,726.9	264.2	253.8	140.8	658.8	161.2	141.3	160.4	462.9	4,516.0
No. 38	2	434.2	687.7	595.3	1,717.2	498.9	684.1	548.9	1,731.9	259.0	243.0	157.4	659.4	181.0	155.3	162.6	498.9	4,607.4
No. 38	3	442.3	635.3	578.8	1,656.4	476.0	663.0	481.8	1,620.8	263.2	253.1	160.3	676.6	170.1	147.7	160.2	478.0	4,431.8
No. 38	4	408.7	651.0	564.0	1,623.7	431.9	662.4	515.6	1,609.9	267.2	239.8	146.7	653.7	179.1	144.1	141.3	464.5	4,351.8
Average per day	......	425.1	656.5	584.6	1,666.2	474.5	671.0	526.9	1,672.4	263.4	247.4	151.3	662.1	172.9	147.1	156.1	476.1	4,476.8
No. 41	1	495.0	801.8	686.3	1,983.1	571.1	802.2	656.4	2,029.7	272.3	268.2	183.7	724.2	153.9	159.8	182.6	496.3	5,233.3
No. 41	2	480.9	800.9	708.0	1,989.8	526.4	784.0	659.8	1,970.2	259.3	242.4	152.0	653.7	172.1	160.4	186.3	518.8	5,132.5
No. 41	3	532.4	833.2	695.3	2,060.9	514.8	772.4	649.6	1,936.8	283.0	263.8	160.0	706.8	180.0	153.1	183.9	517.0	5,221.5
No. 41	4	500.3	888.6	840.0	2,228.9	551.0	776.2	608.1	1,935.3	275.2	258.9	168.8	702.9	177.5	160.9	173.9	512.3	5,379.4
Average per day	......	502.2	831.1	732.4	2,065.7	540.8	783.7	643.5	1,968.0	272.5	258.3	166.1	696.9	170.9	158.5	181.7	511.1	5,241.7
No. 43	1	512.7	777.3	700.8	1,990.8	663.8	847.2	673.6	2,184.6	294.2	283.5	174.5	752.2	184.2	181.7	170.1	536.0	5,463.6
No. 43	2	543.2	855.2	730.2	2,128.6	524.6	720.7	531.9	1,777.2	322.6	289.2	184.8	796.6	180.4	161.0	200.1	541.5	5,243.9
No. 43	3	519.9	729.0	648.9	1,897.8	611.9	798.7	556.0	1,966.6	292.6	259.5	166.8	718.9	167.2	162.7	166.7	496.6	5,079.9
No. 43	4	482.2	776.0	610.1	1,868.3	506.8	744.9	623.3	1,875.0	299.0	304.2	184.8	788.0	188.0	159.0	153.2	500.2	5.031.5
Average per day	......	514.5	784.4	672.5	1,971.4	576.8	777.9	596.2	1,950.9	302.1	284.1	177.7	763.9	179.9	166.1	172.5	518.5	5,204.7
No. 45	1	466.3	812.5	744.4	2,023.2	512.5	793.3	583.5	1,889.3	275.0	275.8	167.3	718.1	182.5	183.7	165.2	531.4	5,162.0
No. 46	1	573.7	860.0	729.7	2,163.4	555.0	794.3	707.8	2,057.1	317.0	266.3	208.1	791.4	176.6	173.6	164.8	515.0	5,526.9
No. 46	2	499.9	760.8	718.7	1,979.4	546.4	783.6	600.4	1,930.4	322.0	273.9	179.6	775.5	175.6	169.4	167.1	512.1	5,197.4
No. 46	3	509.9	776.8	682.0	1,968.7	539.7	781.1	606.3	1,927.1	303.7	278.9	176.0	758.6	181.9	171.0	148.2	501.1	5,155.5
No. 46	4	477.8	763.8	682.5	1,924.1	531.0	785.6	565.4	1,882.0	307.1	267.7	189.4	764.2	173.4	163.3	163.4	500.1	5,070.4
Average per day	......	515.3	790.4	703.2	2,008.9	543.0	786.2	620.0	1,949.2	312.4	271.7	188.3	772.4	176.9	169.3	160.9	507.1	5,237.6
No. 48	1	479.8	798.4	726.9	2,005.1	522.9	815.3	566.3	1,904.	296.8	304.1	181.1	782.0	194.6	186.5	145.3	526.4	5,218.0

No. 52	1	438.5	729.8	676.3	1,844.6	581.7	923.5	772.0	2,277.2	326.8	289.5	208.5	824.8	195.3	164.6	163.3	523.2	5,469.8
No. 52	2	478.3	775.1	702.5	1,955.9	511.6	790.2	605.8	1,907.6	307.7	277.3	196.5	781.5	195.5	159.8	159.3	514.6	5,159.6
No. 52	3	469.5	777.5	703.2	1,950.2	524.9	790.8	654.7	1,970.4	299.9	272.9	200.7	773.5	180.8	177.7	150.1	508.6	5,202.7
Average per day	......	462.1	760.8	694.0	1,916.9	539.4	834.8	677.5	2,051.7	311.5	279.9	201.9	793.3	190.5	167.4	157.6	515.5	5,277.4
No. 54	1	464.3	785.1	645.9	1,895.3	536.0	813.1	645.4	1,994.5	292.6	282.0	193.9	768.5	187.3	166.2	164.4	517.9	5,176.2
No. 54	2	531.8	842.6	686.6	2,061.0	565.2	871.0	487.1	1,923.3	292.2	272.3	190.7	755.2	176.5	184.7	152.2	513.4	5,252.9
No. 54	3	523.5	840.8	743.0	2,107.3	541.2	744.7	579.7	1,865.6	286.8	262.0	182.1	730.9	174.3	176.7	160.8	511.8	5,215.6
Average per day	......	506.5	822.9	691.8	2,021.2	547.5	809.6	570.7	1,927.8	290.5	272.1	188.9	751.5	179.4	175.9	159.1	514.4	5,214.9
Average Nos. 38, 41, 43, 45, 46, and 48	......	487.5	770.0	680.1	1,937.6	532.0	760.2	594.2	1,886.4	287.4	268.1	171.3	726.8	176.6	163.0	166.4	506.0	5,056.8
Average Nos. 52, 54	......	484.3	791.9	692.9	1,969.1	543.4	822.2	624.1	1,989.7	301.0	276.0	195.4	772.4	185.0	171.7	158.3	515.0	5,246.2
Average Nos. 38, 41, 43, 45, 46, 48, 52, and 54	......	486.7	775.5	683.3	1,945.5	534.8	775.7	601.7	1,912.2	290.8	270.1	177.3	738.2	178.7	165.2	164.4	508.3	5,104.2

AMOUNT OF EXTERNAL MUSCULAR WORK DONE.

Table 125 gives the heat equivalent of the work done upon the bicycle-dynamo in the work experiments of the series. In all cases except Nos. 50 and 55 the subject spent eight hours per day propelling the stationary bicycle as described on page 40. In experiment No. 50 the subject was unable to take the food as prescribed and stopped work at the end of five hours, while in experiment No. 55 he worked sixteen hours out of the twenty-four.

TABLE 125.—*Record of work done on stationary bicycle, metabolism experiments Nos. 37, 38, 40, 41, 43, 44, 45, 46, 47, 48, 49, 50, 52, 53, 54, and 55.*

Time.	(*a*) Duration of work period.	(*b*) Rate of work.	(*c*) Heat equivalent of total work, $a \times b \times 0.2378$.	Time.	(*a*) Duration of work period.	(*b*) Rate of work.	(*c*) Heat equivalent of total work, $a \times b \times 0.2378$.
1901. *Experiment No. 37.*	*Seconds.*	*Watts.*	*Calories.*	1901. *Experiment No. 38.*	*Seconds.*	*Watts.*	*Calories.*
Jan. 11, 8.15 a. m.... 10.15 a. m..	7,200	73.0	124.9	Jan. 15, 8.15 a. m.... 10.15 a. m..	7,200	70.0	119.8
10.30 a. m.. 12.30 p. m..	7,200	70.0	119.8	10.30 a. m.. 12.30 p. m..	7,200	73.0	124.9
2.00 p. m... 4.00 p. m...	7,200	68.0	116.4	2.00 p. m... 4.00 p. m...	7,200	72.0	123.3
4.15 p. m... 6.15 p. m...	7,200	74.0	126.7	4.15 p. m... 6.15 p. m...	7,200	72.0	123.3
Total	28,800	....	487.8	Total	28,800	....	491.3
Jan. 12, 8.15 a. m.... 10.15 a. m..	7,200	72.0	123.3	Jan. 16, 8.15 a. m.... 10.15 a. m..	7,200	68.0	116.4
10.30 a. m.. 12.30 p. m..	7,200	82.0	140.4	10.30 a. m.. 12.30 p. m..	7,200	73.0	124.9
2.00 p. m... 4.00 p. m...	7,200	77.0	131.8	2.00 p. m... 4.00 p. m...	7,200	73.0	124.9
4.15 p. m... 6.15 p. m...	7,200	73.0	131.8	4.15 p. m... 6.15 p. m...	7,200	76.0	130.1
Total	28,800	....	527.3	Total	28,800	....	496.3
Jan. 13, 8.15 a. m.... 10.15 a. m..	7,200	77.0	131.8	Jan. 17, 8.15 a. m.... 10.15 a. m..	7,200	72.0	123.3
10.30 a. m.. 12.30 p. m..	7,200	78.0	133.5	10.30 a. m.. 12.30 p. m..	7,200	72.0	123.3
2.00 p. m... 4.00 p. m...	7,200	76.0	130.1	2.00 p. m... 4.00 p. m...	7,200	72.0	123.3
4.15 p. m... 6.15 p. m...	7,200	77.0	131.8	4.15 p. m... 6.15 p. m...	7,200	73.0	124.9
Total	28,800	....	527.2	Total	28,800	....	494.8
Jan. 14, 8.15 a. m.... 10.15 a. m..	7,200	73.0	124.9	Jan. 18, 8.15 a. m.... 10.15 a. m..	7,200	73.0	124.9
10.30 a. m.. 12.30 p. m..	7,200	68.0	116.4	10.30 a. m.. 12.30 p. m..	7,200	73.0	124.9
2.00 p. m... 4.00 p. m...	7,200	70.0	119.8	2.00 p. m... 4.00 p. m...	7,200	73.0	124.9
4.15 p. m... 6.15 p. m...	7,200	70.0	119.8	4.15 p. m... 6.15 p. m...	7,200	72.0	123.3
Total	28,800	....	480.9	Total	28,800	....	498.0
Total, 4 days ..	115,200	....	2,023.2	Total, 4 days ..	115,200	....	1,980.4

TABLE 125. —*Record of work done on stationary bicycle, etc.*—Continued.

Time.	(*a*) Duration of work period.	(*b*) Rate of work.	(*c*) Heat equivalent of total work, $a \times b \times 0.2378$.
1901.			
Experiment No. 40.	*Seconds.*	*Watts.*	*Calories.*
Feb. 26, 8.15 a. m... 10.15 a. m..	7,200	76.0	130.1
10.30 a. m.. 12.30 p. m..	7,200	76.0	130.1
2.00 p. m... 4.00 p. m...	7,200	76.0	130.1
4.15 p. m... 6.15 p. m...	7,200	72.0	123.3
Total	28,800	....	513.6
Feb. 27, 8.15 a. m... 10.15 a. m..	7,200	68.0	116.4
10.30 a. m.. 12.30 p. m..	7,200	76.0	130.1
2.00 p. m... 4.00 p. m...	7,200	76.0	130.1
4.15 p. m... 6.15 p. m ...	7,200	78.0	133.5
Total	28,800	....	510.1
Feb. 28, 8.15 a. m... 10.15 a. m..	7,200	76.0	130.1
10.30 a. m.. 12.30 p. m..	7,200	78.0	133.5
2.00 p. m... 4.00 p. m...	7,200	74.0	126.7
4.15 p. m... 6.15 p. m...	7,200	76.0	130,1
Total	28,800	....	520.4
Mar. 1, 8.15 a. m... 10.15 a. m..	7,200	76.0	130.1
10.30 a. m.. 12.30 p. m..	7,200	76.0	130.1
2.00 p. m... 4.00 p. m...	7,200	76.0	130.1
4.15 p. m... 6.15 p. m...	7,200	80.0	136.9
Total	28,800	....	527.2
Total, 4 days...	115,200	....	2,071.3
Experiment No. 41.			
Mar. 2, 8.15 a. m... 10.15 a. m..	7,200	77.0	131.8
10.30 a. m.. 12.30 p. m..	7,200	76.0	130.1
2.00 p. m... 4.00 p. m...	7,200	78.0	133.5
4.15 p. m... 6.15 p. m...	7,200	77.0	131.8
Total	28,800	....	527.2

Time	(*a*) Duration of work period.	(*b*) Rate of work.	(*c*) Heat equivalent of total work, $a \times b \times 0.2378$.
1901.			
Experiment No. 41—Continued.	*Seconds.*	*Watts.*	*Calories.*
Mar. 3, 8.15 a. m... 10.15 a. m..	7,200	73.0	124.0
10.30 a. m.. 12.30 p. m..	7,200	76.0	130.1
2.00 p. m... 4.00 p. m...	7,200	76.0	130.1
4.15 p. m... 6.15 p. m...	7,200	77.0	131.8
Total	28,800	....	516.0
Mar. 4, 8.15 a. m... 10.15 a. m..	7,200	77.0	131.8
10.30 a. m.. 12.30 p. m..	7,200	76.0	130.1
2.00 p. m... 4.00 p. m...	7,200	72.0	123.3
4.15 p. m... 6.15 p. m...	7,200	76.0	130.1
Total	28,800	....	515.3
Mar. 5, 8.15 a. m... 10.15 a. m..	7,200	78.0	133.5
10.30 a. m.. 12.30 p. m..	7,200	84.0	143.8
2.00 p. m... 4.00 p. m...	7,200	74.0	126.7
4.15 p. m... 6.15 p. m...	7,200	73.0	124.0
Total	28,800	....	528.0
Total, 4 days...	115,200	....	2,086.5
Experiment No. 43.			
Mar. 29, 8.15 a. m... 10.15 a. m..	7,200	86.5	148.1
10.30 a. m.. 12.30 p. m..	7,200	85.5	146.4
2.00 p. m... 4.00 p. m...	7,200	99.6	170.5
4.15 p. m... 6.15 p. m...	7,200	85.5	146.4
Total	28,800	....	611.4
Mar. 30, 8.15 a. m... 10.15 a. m..	7,200	91.0	155.8
10.30 a. m.. 12.30 p. m..	7,200	81.0	138.7
2.00 p. m... 4.00 p. m...	7,200	74.7	127.9
4.15 p. m... 6.15 p. m...	7,200	58.5	100.1
Total	28,800	....	522.5

TABLE 125.—*Record of work done on stationary bicycle, etc.*—Continued.

Time.	(*a*) Duration of work period.	(*b*) Rate of work.	(*c*) Heat equivalent of total work, $a \times b \times 0.2378$.
1901.			
Experiment No. 43—Continued.	*Seconds.*	*Watts.*	*Calories.*
Mar. 31, 8.15 a. m. 10.15 a. m.	7,200	87.5	149.8
10.30 a. m. 12.30 p. m.	7,200	76.5	131.0
2.00 p. m. 4.00 p. m.	7,200	91.5	156.7
4.15 p. m. 6.15 p. m.	7,200	67.5	115.5
Total	28,800	....	553.0
Apr. 1, 8.15 a. m. 10.15 a. m.	7,200	75.5	129.2
10.30 a. m. 12.30 p. m.	7,200	62.5	107.0
2.00 p. m. 4.00 p. m.	7,200	78.0	133.5
4.15 p. m. 6.15 p. m.	7,200	78.0	133.5
Total	28,800	....	503.2
Total, 4 days	115,200	....	2,190.1
Experiment No. 44.			
Apr. 2, 8.15 a. m. 10.15 a. m.	7,200	73.0	125.0
10.30 a. m. 12.30 p. m.	7,200	74.5	127.5
2.00 p. m. 4.00 p. m.	7,200	79.0	135.3
4.15 p. m. 6.15 p. m.	7,200	100.0	171.2
Total	28,800	....	559.0
Apr. 3, 8.15 a. m. 10.15 a. m.	7,200	68.5	117.3
10.30 a. m. 12.30 p. m.	7,200	78.0	133.5
2.00 p. m. 4.00 p. m.	7,200	85.0	145.5
4.15 p. m. 6.15 p. m.	7,200	83.5	143.0
Total	28,800	....	539.3
Apr. 4, 8.15 a. m. 10.15 a. m.	7,200	73.0	125.0
10.30 a. m. 12.30 p. m.	7,200	78.5	134.4
2.00 p. m. 4.00 p. m.	7,200	91.2	156.1
4.15 p. m. 6.15 p. m.	7,200	85.0	145.5
Total	28,800	....	561.0

Time.	(*a*) Duration of work period.	(*b*) Rate of work.	(*c*) Heat equivalent of total work, $a \times b \times 0.2378$.
1901.			
Experiment No. 44—Continued.	*Seconds.*	*Watts.*	*Calories.*
Apr. 5, 8.15 a. m. 10.15 a. m.	7,200	85.5	146.4
10.30 a. m. 12.30 p. m.	7,200	89.7	153.6
2.00 p. m. 4.00 p. m.	7,200	89.5	153.2
4.15 p. m. 6.15 p. m.	7,200	100.0	171.2
Total	28,800	....	624.4
Total, 4 days	115,200	....	2,283.7
Experiment No. 45.			
Apr. 6, 8.15 a. m. 10.15 a. m.	7,200	87.2	149.3
10.30 a. m. 12.30 p. m.	7,200	88.7	151.9
2.00 p. m. 4.00 p. m.	7,200	86.0	147.2
4.15 p. m. 6.15 p. m.	7,200	75.0	128.4
Total	28,800	....	576.8
Experiment No. 46.			
May 3, 8.15 a. m. 10.15 a. m.	7,200	94.0	160.9
10.30 a. m. 12.30 p. m.	7,200	87.0	148.9
2.00 p. m. 4.00 p. m.	7,200	76.5	131.0
4.15 p. m. 6.15 p. m.	7,200	89.8	153.7
Total	28,800	....	594.5
May 4, 8.15 a. m. 10.15 a. m.	7,200	81.0	138.7
10.30 a. m. 12.30 p. m.	7,200	81.2	139.0
2.00 p. m. 4.00 p. m.	7,200	79.8	136.6
4.15 p. m. 6.15 p. m.	7,200	74.2	127.0
Total	28,800	....	541.3
May 5, 8.15 a. m. 10.15 a. m.	7,200	80.2	137.3
10.30 a. m. 12.30 p. m.	7,200	79.8	136.6
2.00 p. m. 4.00 p. m.	7,200	79.4	136.0
4.15 p. m. 6.15 p. m.	7,200	73.5	125.8
Total	28,800	....	535.7

Table 125.—*Record of work done on stationary bicycle, etc.*—Continued.

Time.	(a) Duration of work period.	(b) Rate of work.	(c) Heat equivalent of total work, $a\times b$ $\times 0.2378$.
1901.			
Experiment No. 46—Continued.	*Seconds.*	*Watts.*	*Calories.*
May 6, 8.15 a. m. 10.15 a. m.	7,200	79.5	136.1
10.30 a. m. 12.30 p. m.	7,200	81.2	139.0
2.00 p. m. 4.00 p. m.	7,200	78.3	134.0
4.15 p. m. 6.15 p. m.	7,200	72.7	124.5
Total	28,800	....	533.6
Total, 4 days	115,200	....	2,205.1
Experiment No. 47.			
May 7, 8.15 a. m. 10.15 a. m.	7,200	85.0	145.5
10.30 a. m. 12.30 p. m.	7,200	85.0	145.5
2.00 p. m. 4.00 p. m.	7,200	82.0	140.4
4.15 p. m. 6.15 p. m.	7,200	82.0	140.4
Total	28,800	....	571.8
May 8, 8.15 a. m. 10.15 a. m.	7,200	82.3	140.9
10.30 a. m. 12.30 p. m.	7,200	84.2	144.1
2.00 p. m. 4.00 p. m.	7,200	78.0	133.5
4.15 p. m. 6.15 p. m.	7,200	77.5	132.7
Total	28,800	....	551.2
May 9, 8.15 a. m. 10.15 a. m.	7,200	86.8	148.6
10.30 a. m. 12.30 p. m.	7,200	83.8	143.5
2.00 p. m. 4.00 p. m.	7,200	78.0	133.5
4.15 p. m. 6.15 p. m.	7,200	70.6	120.9
Total	28,800	....	546.5
May 10, 8.15 a. m. 10.15 a. m.	7,200	85.9	147.0
10.30 a. m. 12.30 p. m.	7,200	85.9	147.0
2.00 p. m. 4.00 p. m.	7,200	81.5	139.5
4.15 p. m. 6.15 p. m.	7,200	84.9	145.3
Total	28,800	....	578.8
Total, 4 days	115,200	....	2,248.3

Time.	(a) Duration of work period.	(b) Rate of work.	(c) Heat equivalent of total work, $a\times b$ $\times 0.2378$.
1901.			
Experiment No. 48.	*Seconds.*	*Watts.*	*Calories.*
May 11, 8.15 a. m. 10.15 a. m.	7,200	78.0	133.5
10.30 a. m. 12.30 p. m.	7,200	85.0	145.5
2.00 p. m. 4.00 p. m.	7,200	80.3	137.5
4.15 p. m. 6.15 p. m.	7,200	78.0	133.5
Total	28,800	....	550.0
1902.			
Experiment No. 49.			
Mar. 27, 8.15 a. m. 10.15 a. m.	7,200	69.1	118.2
10.30 a. m. 12.30 p. m.	7,200	69.1	118.2
2.00 p. m. 4.00 p. m.	7,200	84.8	145.1
4.15 p. m. 6.15 p. m.	7,200	104.1	178.1
Total	28,800	....	559.6
Mar. 28, 8.15 a. m. 10.15 a. m.	7,200	75.0	128.4
10.30 a. m. 12.30 p. m.	7,200	67.8	116.1
2.00 p. m. 4.00 p. m.	7,200	76.5	130.9
4.15 p. m. 6.15 p. m.	7,200	66.4	113.6
Total	28,800	....	489.0
Mar. 29, 8.15 a. m. 10.15 a. m.	7,200	65.0	111.3
10.30 a. m. 12.30 p. m.	7,200	60.5	103.6
2.00 p. m. 4.00 p. m.	7,200	71.5	122.4
4.15 p. m. 6.15 p. m.	7,200	93.5	160.1
Total	28,800	....	497.4
Total, 3 days	86,400	....	1,546.0
Experiment No 50.			
Mar. 30, 8.15 a. m. 10.15 a. m.	7,200	72.3	123.8
10.30 a. m. 12.30 p. m.	7,200	76.8	131.4
2.00 p. m. 3.00 p. m.	3,600	60.9	52.1
Total	18,000	....	307.3

TABLE 125.—*Record of work done on stationary bicycle, etc.*—Continued.

Time.	(*a*) Duration of work period.	(*b*) Rate of work.	(*c*) Heat equivalent of total work, $a \times b \times 0.2378$.
1902.			
Experiment No. 52.	*Seconds.*	*Watts.*	*Calories.*
Apr. 21, 8.15 a. m.–10.15 a. m.	7,200	77.0	131.8
10.30 a. m.–12.30 p. m.	7,200	85.2	145.9
2.00 p. m.–4.00 p. m.	7,200	104.0	178.1
4.15 p. m.–6.15 p. m.	7,200	113.0	193.3
Total	28,800	....	649.1
Apr. 22, 8.15 a. m.–10.15 a. m.	7,200	88.5	151.5
10.30 a. m.–12.30 p. m.	7,200	83.5	143.0
2.00 p. m.–4.00 p. m.	7,200	85.0	145.5
4.15 p. m.–6.15 p. m.	7,200	85.0	145.5
Total	28,800	....	585.5
Apr. 23, 8.15 a. m.–10.15 a. m.	7,200	83.5	143.0
10.30 a. m.–12.30 p. m.	7,200	85.0	145.5
2.00 p. m.–4.00 p. m.	7,200	85.0	145.5
4.15 p. m.–6.15 p. m.	7,200	88.5	151.5
Total	28,800	....	585.5
Total, 3 days	86,400	....	1,820.1
Experiment No. 53.			
Apr. 24, 8.15 a. m.–10.15 a. m.	7,200	83.5	143.0
10.30 a. m.–12.30 p. m.	7,200	85.0	145.5
2.00 p. m.–4.00 p. m.	7,200	83.5	143.0
4.15 p. m.–6.15 p. m.	7,200	85.0	145.0
Total	28,800	....	576.5

Time.	(*a*) Duration of work period.	(*b*) Rate of Work.	(*c*) Heat equivalent of total work, $a \times b \times 0.2378$.
1902.			
Experiment No. 53—Continued.	*Seconds.*	*Watts.*	*Calories.*
Apr. 25, 8.15 a. m.–10.15 a. m.	7,200	90.5	154.9
10.30 a. m.–12.30 p. m.	7,200	85.0	145.5
2.00 p. m.–4.00 p. m.	7,200	86.5	148.1
4.15 p. m.–6.15 p. m.	7,200	86.5	148.1
Total	28,800	....	596.6
Apr. 26, 8.15 a. m.–10.15 a. m.	7,200	90.5	154.9
10.30 a. m.–12.30 p. m.	7,200	86.5	148.1
2.00 p. m.–4.00 p. m.	7,200	86.5	148.1
4.15 p. m.–6.15 p. m.	7,200	80.5	137.8
Total	28,800	....	588.9
Total, 3 days	86,400	....	1,762.0
Experiment No. 54.			
Apr. 27, 8.15 a. m.–10.15 a. m.	7,200	85.0	145.5
10.30 a. m.–12.30 p. m.	7,200	85.0	145.5
2.00 p. m.–4.00 p. m.	7,200	90.5	154.9
4.15 p. m.–6.15 p. m.	7,200	92.2	157.9
Total	28,800	....	603.8
Apr. 28, 8.15 a. m.–10.15 a. m.	7,200	94.0	160.9
10.30 a. m.–12.30 p. m.	7,200	92.2	150.0
2.00 p. m.–4.00 p. m.	7,200	92.2	152.6
4.15 p. m.–6.15 p. m.	7,200	99.0	125.7
Total	28,800	....	589.2

TABLE 125.—*Record of work done on stationary bicycle, etc.*—Continued.

Time.	(a) Duration of work period.	(b) Rate of work.	(c) Heat equivalent of total work, $a \times b \times 0.2378$.	Time.	(a) Duration of work period.	(b) Rate of work.	(c) Heat equivalent of total work, $a \times b \times 0.2378$.
1902.				1902.			
Experiment No. 54—Continued.	*Seconds.*	*Watts.*	*Calories.*	*Experiment No. 55*—Continued.	*Seconds.*	*Watts.*	*Calories.*
Apr. 29, 8.15 a. m... 10.15 a. m..	7,200	94.0	160.9	Apr. 30, 1.55 p. m... 4.10 p. m...	† 7,830	118.0	219.7
10.30 a. m.. 12.30 p. m..	7,200	92.2	157.9	4.17½ p. m.. 6.20 p. m...	† 7,080	115.0	193.6
2.00 p. m... 4.00 p. m...	7,200	79.0	135.2	7.50 p. m... 10.00 p. m..	‡ 7,500	104.0	185.5
4.15 p. m... 6.15 p. m...	7,200	80.2	137.3	10.11 p. m.. 12.00 p. m..	§ 5,430	104.0	134.3
Total	28,800	....	591.3	May 1, 12.08 a. m.. 1.00 a. m...	3,120	104.0	77.2
Total, 3 days...	86,400	....	1,784.3	4.13 a. m... 5.00 a. m...	2,820	104.0	69.7
Experiment No. 55.				5.10 a. m... 7.00 a. m...	6,600	87.5	137.3
Apr. 30, 7.53 a. m... 10.25 a. m..	* 8,940	115.0	244.5	Total	57,540	....	1,481.7
10.30 a. m.. 12.50 p. m..	* 8,220	102.5	219.9				

* 3 minutes taken out for weighing absorbers.
† 4½ minutes taken out for weighing absorbers.
‡ 5 minutes taken out for weighing absorbers.
§ 18½ minutes taken out for weighing absorbers.

TABLE 126.—*Income and outgo of energy in metabolism experiments Nos. 35–55 with J. C. W.*

Experiment No.	Character.	Income of energy. From protein. Of food.	From protein. Of body.	From protein. Total.	From fat. Of food.	From fat. Of body.	From fat. Total.	From carbohydrates.	Total. From food.	Total. From body.	Total. Grand total.	Outgo of energy. As heat.	As external muscular work.	Total.
		Calories.	Calories.	Calories.	Calories.	Calories.	Calories.	Calories.	Calories.	Calories.	Calories.	Calories.	Calories.	Calories.
36	Rest, without food	0	311	311	0	2,062	2,062	0	0	2,373	2,373	2,253	0	2,253
39	.....do	0	434	434	0	1,708	1,708	0	0	2,142	2,142	2,027	0	2,027
42	.....do	0	390	390	0	1,663	1,663	0	0	2,053	2,053	1,946	0	1,946
51	Rest, without food, first day	0	317	317	0	2,033	2,033	0	0	2,350	2,350	2,362	0	2,362
51	Rest, without food, second day	0	339	339	0	1,995	1,995	0	0	2,334	2,334	2,348	0	2,348
	Average 2 days of experiment No. 51	0	328	328	0	2,014	2,014	0	0	2,342	2,342	2,355	0	2,355
	Average, 5 days	0	358	358	0	1,892	1,892	0	0	2,250	2,250	2,187	0	2,187
35	Rest, with food	401	28	429	767	47	814	1,114	2,282	75	2,357	2,397	0	2,397
37	Work, carbohydrate diet	398	48	446	613	1,304	1,917	2,458	3,469	1,352	4,821	4,258	506	4,764
40	.....do	389	57	446	574	994	1,568	3,237	4,200	1,051	5,251	4,705	518	5,223
44	.....do	385	55	440	591	449	1,040	3,645	4,621	504	5,125	4,627	571	5,198
47	.....do	376	42	418	621	749	1,370	3,385	4,382	791	5,173	4,686	562	5,248
49	.....do	470	a—13	457	858	a—88	770	3,861	5,189	a—101	5,088	4,730	515	5,245
53	.....do	398	a— 6	392	841	a—20	821	3,891	5,128	a— 26	5,104	4,591	587	5,178
	Average of experiments Nos. 37, 40, 44, and 47	387	51	438	600	874	1,474	3,181	4,168	925	5,093	4,569	539	5,108
	Average of experiments Nos. 49 and 53	434	a— 9	425	849	a—54	795	3,876	5,159	a— 63	5,096	4,660	551	5,211
	Average of experiments Nos. 37, 40, 44, 47, 49, and 53, by days	400	34	434	668	620	1,288	3,371	4,439	654	5,093	4,594	543	5,137
38	Work, fat diet	418	134	552	1,839	1,001	2,840	1,181	3,438	1,135	4,573	3,982	495	4,477
41	.....do	411	132	543	2,516	981	3,497	1,264	4,191	1,113	5,304	4,720	522	5,242
43	.....do	398	407	505	2,610	518	3,128	1,522	4,530	625	5,155	4,657	548	5,205
46	.....do	404	22	426	2,614	683	3,297	1,470	4,488	705	5,193	4,686	551	5,237

45	.....do..........................	400	110	510	2,545	658	3,203	1,544	4,489	768	5,257	4,585	577	5,162
48	.....do..........................	399	63	462	2,530	798	3,328	1,507	4,436	861	5,297	4,668	550	5,218
52	.....do..........................	424	9	433	2,971	177	3,148	1,728	5,123	186	5,309	4,670	607	5,277
54	.....do..........................	436	14	450	2,978	196	3,174	1,730	5,144	210	5,354	4,620	595	5,215
	Average of experiments Nos. 38, 41, 43, and 46.....	408	99	507	2,395	796	3,191	1,359	4,162	894	5,056	4,512	529	5,041
	Average of experiments Nos. 45 and 48	400	86	486	2,538	728	3,266	1,525	4,463	814	5,277	4,626	564	5,190
	Average of experiments Nos. 52 and 54...........	430	12	442	2,975	186	3,161	1,729	5,134	198	5,332	4,645	601	5,246
	Average, all, by days	413	76	489	2,552	638	3,190	1,465	4,430	714	5,144	4,556	550	5,106
50	Work, insufficient food	254	111	365	1,203	1,847	3,050	929	2,386	1,958	4,344	3,827	307	4,134
55	Extra work, insufficient food ...	434	44	478	2,945	4,799	7,744	1,759	5,138	4,843	9,981	7,832	1,482	9,314

a Body material stored.

BODY WEIGHT, PULSE RATE, AND TEMPERATURE.

Table 127 summarizes the body weight, pulse rate, and temperature as recorded by the subject in a diary kept for the purpose. In addition to the figures here given, the body temperature was taken by means of a specially constructed rectal thermometer,[a] the readings of which were taken by the observer outside. In experiments Nos. 43–48, inclusive, the subject did not record his temperature.

TABLE 127.—*Body weight, pulse rate, and temperature as recorded by the subject, metabolism experiments Nos. 35–55, inclusive.*

Time.	Weight in underclothes.	Pulse rate.	Temperature.
1900.			
Experiment No. 35.	*Kilos.*		°*F.*
Dec. 9, 6.50 a. m.	....	74.0	97.1
7.05 a. m.	76.12	....	....
12.50 p. m.	....	63.0	97.8
3.20 p. m.	....	69.0	....
3.50 p. m.	....	64.0	....
4.20 p. m.	....	65.0	....
4.50 p. m.	....	66.0	....
5.20 p. m.	....	66.2	....
5.50 p. m.	....	65.0	....
6.20 p. m.	....	68.0	....
6.50 p. m.	....	68.0	98.2
7.20 p. m.	....	70.0	....
7.50 p. m.	....	70.0	....
8.20 p. m.	....	70.0	....
8.50 p. m.	....	69.0	....
9.20 p. m.	....	64.0	....
9.50 p. m.	....	58.0	....
10.20 p. m.	....	58.0	97.8
10.50 p. m.	....	57.0	....
Dec. 10, 6.50 a. m.	....	72.0	97.1
7.00 a. m.	76.00	....	....
7.20 a. m.	....	73.0	....
7.50 a. m.	....	76.0	....
8.20 a. m.	....	85.0	....
8.50 a. m.	....	85.0	....
9.20 a. m.	....	83.5	....
9.50 a. m.	....	70.0	....
10.20 a. m.	....	68.5	....
10.50 a. m.	....	64.0	....
11.20 a. m.	....	62.5	....
11.50 a. m.	....	61.0	....
12.20 p. m.	....	61.0	....
12.50 p. m.	....	60.0	98.0
1.20 p. m.	....	71.0	....
1.50 p. m.	....	73.0	....
2.50 p. m.	....	74.0	....
3.20 p. m.	....	73.0	....
3.50 p. m.	....	71.0	....
4.20 p. m.	....	64.0	....
4.50 p. m.	....	66.0	....
1900.			
Experiment No. 35— Continued.	*Kilos.*		°*F.*
Dec. 10, 5.20 p. m.	....	64.0	....
5.50 p. m.	....	61.0	....
6.20 p. m.	....	58.0	....
6.50 p. m.	....	61.0	98.2
7.20 p. m.	....	60.5	....
7.50 p. m.	....	60.0	....
8.20 p. m.	....	61.0	....
8.50 p. m.	....	60.5	....
9.20 p. m.	....	59.0	....
9.50 p. m.	....	60.0	....
10.20 p. m.	....	58.0	97.7
Dec. 11, 6.50 a. m.	....	74.5	97.2
7.10 a. m.	76.90	....	....
7.20 a. m.	....	71.0	....
7.50 a. m.	....	76.0	....
8.20 a. m.	....	79.0	....
8.50 a. m.	....	78.0	....
9.20 a. m.	....	75.0	....
9.50 a. m.	....	75.0	....
10.20 a. m.	....	68.0	....
10.50 a. m.	....	64.0	....
11.20 a. m.	....	65.0	....
11.50 a. m.	....	63.0	....
12.20 p. m.	....	63.0	....
12.50 p. m.	....	64.0	98.3
1.20 p. m.	....	68.0	....
1.50 p. m.	....	69.0	....
2.20 p. m.	....	74.0	....
2.50 p. m.	....	74.0	....
3.20 p. m.	....	75.0	....
3.50 p. m.	....	74.0	....
4.20 p. m.	....	69.0	....
4.50 p. m.	....	75.0	....
5.20 p. m.	....	70.0	....
5.50 p. m.	....	67.0	....
6.20 p. m.	....	69.0	....
6.50 p. m.	....	73.0	98.3
7.20 p. m.	....	72.0	....
7.50 p. m.	....	70.0	....
8.20 p. m.	....	68.0	....

[a] For description see Benedict and Snell, Eine neue Methode um Körpertemperaturen zu messen. Arch. Physiol. [Pflüger], 88 (1901), p. 492.

TABLE 127.—*Body weight, pulse rate, and temperature, etc.*—Continued.

Time.	Weight in under-clothes.	Pulse rate.	Tempera-ture.	Time.	Weight in under-clothes.	Pulse rate.	Tempera-ture.
1900.				1900.			
Experiment No. 35—Continued.	*Kilos.*		°*F.*	*Experiment No. 36*—Continued.	*Kilos.*		°*F*
Dec. 11, 8.50 p. m.		67.0		Dec. 13, 12.20 p. m.		62.0	
9.20 p. m.		62.0		12.50 p. m.		62.0	98.0
10.20 p. m.		58.0	97.9	1.20 p. m.		59.0	
10.50 p. m.		67.0		1.50 p. m.		59.0	97.8
Dec. 12, 6.50 a. m.		74.0	97.2	2.20 p. m.		57.0	
7.10 a. m.	75.95			2.50 p. m.		64.0	98.0
7.20 a. m.		75.0		3.20 p. m.		62.0	
7.50 a. m.		72.0	98.3	3.50 p. m.		59.0	97.7
8.20 a. m.		86.0		4.20 p. m.		62.0	
8.50 a. m.		81.0	98.5	4.50 p. m.		57.0	98.1
9.20 a. m.		80.0		5.20 p. m.		59.0	
9.50 a. m.		73.0	98.0	5.50 p. m.		59.0	97.8
10.20 a. m.		73.0		6.20 p. m.		58.0	
10.50 a. m.		72.0	98.1	6.50 p. m.		61.0	98.2
11.20 a. m.		66.0		7.20 p. m.		60.0	
11.50 a. m.		65.0	98.2	7.50 p. m.		54.0	97.9
12.20 p. m.		62.0		8.20 p. m.		59.0	
12.50 p. m.		64.0	98.3	8.50 p. m.		56.0	97.7
1.20 p. m.		71.0		9.20 p. m.		57.0	
1.50 p. m.		70.0	97.6	9.50 p. m.		58.0	97.7
2.20 p. m.		74.0		10.20 p. m.		55.0	97.4
2.50 p. m.		75.0	98.5	10.50 p. m.		52.0	97.0
3.20 p. m.		72.0		Dec. 14, 6.50 a. m.		71.0	97.8
3.50 p. m.		71.0	98.4	7.05 a. m.	73.56		
4.20 p. m.		68.0		1901.			
4.50 p. m.		67.0	98.4	*Experiment No. 37.*			
5.20 p. m.		65.0					
5.50 p. m.		63.0	98.3	Jan. 11, 6.50 a. m.		66.0	97.6
6.20 p. m.		62.0		7.00 a. m.	76.98		
6.50 p. m.		59.0	98.2	12.50 p. m.		68.0	
7.20 p. m.		63.0		6.50 p. m.		83.0	98.4
7.50 p. m.		64.0	98.1	7.00 p. m.	75.83		
8.20 p. m.		60.0		10.50 p. m.		61.0	99.7
8.50 p. m.		59.0	98.1	Jan. 12, 6.50 a. m.		71.0	97.1
9.20 p. m.		66.0		7.00 a. m.	74.32		
9.50 p. m.		63.0	98.2	12.50 p. m.		64.0	97.5
10.20 p. m.		61.0	97.8	6.50 p. m.		82.0	98.2
Dec. 13, 6.50 a. m.		75.0	97.1	7.00 p. m.	74.66		
Experiment No. 36.				10.50 p. m.		65.0	97.9
				Jan. 13, 6.50 a. m.		68.0	96.9
Dec. 13, 7.10 a. m.	75.87			7.00 a. m.	74.24		
7.20 a. m.		70.0		12.50 p. m.		70.0	97.3
7.50 a. m.		73.0	98.2	6.50 p. m.		76.0	98.1
8.20 a. m.		67.0		7.00 p. m.	74.22		
8.50 a. m.		65.0	98.1	10.50 p. m.		61.0	97.0
9.20 a. m.		67.0		Jan. 14, 6.50 a. m.		68.0	96.8
9.50 a. m.		62.0	98.0	7.00 a. m.	73.80		
10.20 a. m.		57.0		12.50 p. m.		64.0	97.3
10.50 a. m.		63.0	98.2	6.50 p. m.		67.0	97.6
11.20 a. m.		63.0		7.00 p. m.	74.58		
11.50 a. m.		62.0	98.0	Jan. 15, 6.50 a. m.		66.0	96.8

TABLE 127.—*Body weight, pulse rate, and temperature, etc.*—Continued.

Time.	Weight in underclothes.	Pulse rate.	Temperature.
1901.			
Experiment No. 38.	*Kilos.*		*°F.*
Jan. 15, 7.00 a. m.	74.10		
12.50 p. m.		64.0	97.0
6.50 p. m.		72.0	97.6
7.00 p. m.	74.55		
10.50 p. m.		55.0	96.4
Jan. 16, 6.50 a. m.		65.0	96.8
7.00 a. m.	74.40		
12.50 p. m.		67.0	97.1
6.50 p. m.		74.0	98.1
7.00 p. m.	74.14		
10.50 p. m.		64.0	97.6
Jan. 17, 6.50 a. m.		69.0	96.6
7.00 a. m.	73.48		
12.50 p. m.		68.0	97.6
6.50 p. m.		75.0	97.6
7.00 p. m.	73.67		
10.50 p. m.		60.0	97.1
Jan. 18, 6.50 a. m.		64.0	96.5
7.00 a. m.	73.20		
12.50 p. m.		64.0	96.5
6.50 p. m.		78.0	98.3
7.00 p. m.	73.50		
10.50 p. m.		56.0	97.0
Jan. 19, 6.50 a. m.		61.0	96.4
Experiment No. 39.			
Jan. 19, 7.00 a. m.	72.95		
12.50 p. m.		49.0	97.1
6.50 p. m.		47.0	96.9
7.00 p. m.	73.78		
10.50 p. m.		44.0	96.9
Jan. 20, 6.50 a. m.		53.0	96.8
7.00 a. m.	72.80		
Experiment No. 40.			
Feb. 26, 6.50 a. m.		74.0	
7.00 a. m.	78.80		
7.50 a. m.		84.0	
9.15 a. m.		83.0	
10.00 a. m.		112.0	
10.25 a. m.		74.0	
10.50 a. m.		106.0	
11.50 a. m.		108.0	
12.50 p. m.		75.0	
2.30 p. m.		120.0	
5.20 p. m.		107.0	
6.50 p. m.		85.0	
7.00 p. m.	78.60		
8.00 p. m.		83.0	
9.30 p. m.		81.0	
10.50 p. m.		63.0	
Feb. 27, 6.50 a. m.		73.0	
1901.			
Experiment No. 40—Continued.	*Kilos.*		*°F.*
Feb. 27, 7.00 a. m.	78.05		
9.30 a. m.		112.0	
12.20 p. m.		101.0	
12.50 p. m.		74.0	
4.50 p. m.		104.0	
6.50 p. m.		75.0	
7.00 p. m.	78.40		
8.00 p. m.		81.0	
9.40 p. m.		73.0	
10.50 p. m.		62.0	
Feb. 28, 6.50 a. m.		65.0	
7.00 a. m.	77.85		
8.50 a. m.		115.0	
9.50 a. m.		111.0	
12.50 p. m.		69.0	
5.20 p. m.		106.0	
6.50 p. m.		80.0	
7.00 p. m.	78.42		
7.40 p. m.		84.0	
9.10 p. m.		76.0	
9.40 p. m.		68.0	
10.50 p. m.		62.0	
Mar. 1, 6.50 a. m.		67.0	
7.00 a. m.	77.96		
8.50 a. m.		110.0	
9.50 a. m.		110.0	
10.50 a. m.		101.0	
11.50 a. m.		100.0	
2.50 p. m.		112.0	
3.50 p. m.		110.0	
6.50 p. m.		79.0	
7.00 p. m.	78.41		
9.20 p. m.		64.0	
9.50 p. m.		66.0	
10.50 p. m.		60.0	
Mar. 2, 6.50 a. m.		69.0	
Experiment No. 41.			
Mar. 2, 7.00 a. m.	77.82		
8.50 a. m.		117.0	
10.50 a. m.		96.0	
11.50 a. m.		98.0	
12.50 p. m.		71.0	
2.50 p. m.		110.0	
3.50 p. m.		106.0	
4.50 p. m.		106.0	
6.50 p. m.		81.0	
7.00 p. m.	78.29		
7.30 p. m.		80.0	
10.50 p. m.		54.0	
Mar. 3, 6.50 a. m.		70.0	
7.00 a. m.	78.09		

TABLE 127.—*Body weight, pulse rate, and temperature, etc.*—Continued.

Time.	Weight in under-clothes.	Pulse rate.	Tempera-ture.	Time.	Weight in under-clothes.	Pulse rate.	Tempera-ture.
1901.				1901.			
Experiment No. 41—Continued.	*Kilos.*		°*F.*	*Experiment No. 41*—Continued.	*Kilos.*		°*F.*
Mar. 3, 9.50 a. m	....	104.0	....	Mar. 5, 10.20 p. m	....	64.0	....
11.50 a. m	....	100.0	....	10.50 p. m	....	64.0	....
12.50 p. m	....	74.0	....	Mar. 6, 6.50 a. m	....	63.0	....
2.50 p. m	....	109.0	....	*Experiment No. 42.*			
3.50 p. m	....	96.0	....	Mar. 6, 7.00 a. m	77.04	....	....
4.50 p. m	....	106.0	....	9.00 a. m	....	54.0	....
6.50 p. m	....	79.0	....	10.20 a. m	....	52.0	....
7.00 p. m	78.07	....	....	11.20 a. m	....	53.0	....
7.50 p. m	....	81.0	....	12.20 p. m	....	52.0	....
9.20 p. m	....	72.0	....	2.20 p. m	....	52.0	....
9.50 p. m	....	68.0	....	3.20 p. m	....	54.0	....
10.20 p. m	....	65.0	....	4.20 p. m	....	51.0	....
10.50 p. m	....	58.0	....	5.20 p. m	....	51.0	....
Mar. 4, 6.50 a. m	....	72.0	....	6.50 p. m	....	50.0	....
7.00 a. m	77.84	....	....	7.50 p. m	....	48.0	....
8.50 a. m	....	118.0	....	8.50 p. m	....	47.0	....
9.50 a. m	....	110.0	....	9.50 p. m	....	46.0	....
10.50 a. m	....	100.0	....	10.50 p. m	....	46.0	....
11.50 a. m	....	94.0	....	Mar. 7, 6.50 a. m	....	61.0	....
12.50 p. m	....	70.0	....	7.00 a. m	75.79	....	....
2.50 p. m	....	110.0	....	*Experiment No. 43.*			
3.50 p. m	....	102.0	....	Mar. 29, 6.50 a. m	....	75.0	....
4.50 p. m	....	103.0	....	7.00 a. m	79.16	....	....
5.50 p. m	....	100.0	....	9.50 a. m	....	112.0	....
6.50 p. m	....	79.0	....	10.50 a. m	....	102.0	....
7.00 p. m	77.74	....	....	11.50 a. m	....	102.0	....
7.50 p. m	....	83.0	....	12.50 p. m	....	82.0	....
8.20 p. m	....	76.0	....	2.50 p. m	....	132.0	....
8.50 p. m	....	74.0	....	3.50 p. m	....	114.0	....
9.20 p. m	....	73.0	....	5.50 p. m	....	116.0	....
9.50 p. m	....	75.0	....	6.50 p. m	....	99.0	....
10.20 p. m	....	73.0	....	7.00 p. m	79.42	....	....
10.50 p. m	....	61.0	....	7.50 p. m	....	98.0	....
Mar. 5, 6.50 a. m	....	67.0	....	8.20 p. m	....	94.0	....
7.00 a. m	77.35	....	....	9.20 p. m	....	91.0	....
8.50 a. m	....	118.0	....	9.50 p. m	....	85.0	....
9.50 a. m	....	114.0	....	10.50 p. m	....	78.0	....
10.50 a. m	....	108.0	....	Mar. 30, 6.50 a. m	....	71.0	....
11.50 a. m	....	114.0	....	7.00 a. m	78.99	....	....
12.50 p. m	....	76.0	....	8.50 a. m	....	114.0	....
2.50 p. m	....	112.0	....	9.50 a. m	....	118.0	....
3.50 p. m	....	110.0	....	10.50 a. m	....	109.0	....
4.50 p. m	....	100.0	....	11.50 a. m	....	110.0	....
5.50 p. m	....	101.0	....	12.50 p. m	....	81.0	....
6.50 p. m	....	87.0	....	2.50 p. m	....	114.0	....
7.00 p. m	77.42	....	....	3.50 p. m	....	112.0	....
7.50 p. m	....	85.0	....	4.50 p. m	....	100.0	....
8.20 p. m	....	84.0	....	5.50 p. m	....	99.0	....
8.50 p. m	....	82.0	....	6.50 p. m	....	97.0	....
9.20 p. m	....	78.0	....	7.00 p. m	79.58	....	....
9.50 p. m	....	76.0	....				

TABLE 127.—*Body weight, pulse rate, and temperature, etc.*—Continued.

Time.	Weight in underclothes.	Pulse rate.	Temperature.	Time.	Weight in underclothes.	Pulse rate.	Temperature.
1901.				1901.			
Experiment No. 43—Continued.	*Kilos.*		°*F.*	*Experiment No. 44*—Continued.	*Kilos.*		°*F.*
Mar. 30, 7.50 p. m.		95.0		Apr. 2, 7.50 p. m.		94.0	
8.50 p. m.		88.0		10.00 p. m.		78.0	
10.50 p. m.		72.0		10.50 p. m.		67.0	
Mar. 31, 6.50 a. m.		75.0		Apr. 3, 6.50 a. m.		69.0	
7.00 a. m.	78.82			7.00 a. m.	78.62		
8.50 a. m.		114.0		8.50 a. m.		114.0	
9.50 a. m.		108.0		9.50 a. m.		109.0	
9.55 a. m.		105.0		10.50 a. m.		104.0	
10.50 a. m.		95.0		11.50 a. m.		98.0	
11.50 a. m.		103.0		12.50 p. m.		72.0	
12.50 p. m.		77.0		2.50 p. m.		114.0	
2.50 p. m.		118.0		3.50 p. m.		111.0	
3.50 p. m.		116.0		4.50 p. m.		106.0	
4.50 p. m.		106.0		5.50 p. m.		100.0	
5.50 p. m.		99.0		6.50 p. m.		81.0	
6.50 p. m.		90.0		7.00 p. m.	79.63		
7.00 p. m.	79.49			7.50 p. m.		91.0	
7.50 p. m.		92.0		10.00 p. m.		71.0	
8.50 p. m.		82.0		10.50 p. m.		61.0	
10.00 p. m.		80.0		Apr. 4, 6.50 a. m.		71.0	
10.50 p. m.		71.0		7.00 a. m.	78.92		
Apr. 1, 6.50 a. m.		67.0		8.50 a. m.		108.0	
7.00 a. m.	78.68			9.50 a. m.		110.0	
8.50 a. m.		109.0		10.50 a. m.		100.0	
10.05 a. m.		102.0		11.50 a. m.		97.0	
11.45 a. m.		89.0		12.50 p. m.		73.0	
12.50 p. m.		78.0		2.50 p. m.		114.0	
2.45 p. m.		114.0		3.50 p. m.		112.0	
3.55 p. m.		106.0		4.50 p. m.		106.0	
4.55 p. m.		102.0		5.50 p. m.		97.0	
5.55 p. m.		103.0		6.50 p. m.		88.0	
6.50 p. m.		87.0		7.00 p. m.	79.46		
7.00 p. m.	79.38			7.50 p. m.		90.0	
7.50 p. m.		94.0		10.00 p. m.		72.0	
8.50 p. m.		85.0		10.50 p. m.		63.0	
10.00 p. m.		75.0		Apr. 5, 6.50 a. m.		70.0	
10.50 p. m.		70.0		7.00 a. m.	78.92		
Apr. 2, 6.50 a. m.		69.0		8.50 a. m.		114.0	
Experiment No. 44.				9.50 a. m.		113.0	
Apr. 2, 7.00 a. m.	78.51			10.50 a. m.		101.0	
8.50 a. m.		116.0		11.50 a. m.		104.0	
9.50 a. m.		106.0		12.50 p. m.		75.0	
10.50 a. m.		106.0		2.50 p. m.		112.0	
11.50 a. m.		94.0		3.50 p. m.		106.0	
12.50 p. m.		73.0		4.50 p. m.		106.0	
2.50 p. m.		107.0		6.50 p. m.		88.0	
3.50 p. m.		109.0		7.00 p. m.	79.35		
4.50 p. m.		109.0		7.50 p. m.		89.0	
5.50 p. m.		131.0		10.00 p. m.		76.0	
6.50 p. m.		89.0		10.50 p. m.		65.0	
7.00 p. m.	79.14			Apr. 6, 6.50 a. m.		73.0	

TABLE 127.—*Body weight, pulse rate, and temperature, etc.*—Continued.

Time.	Weight in underclothes.	Pulse rate.	Temperature.
1901.			
Experiment No 45.	*Kilos.*		*°F.*
Apr. 6, 7.00 a. m.	78.71		
8.50 a. m.		113.0	
9.50 a. m.		100.0	
10.50 a. m.		98.0	
11.50 a. m.		94.0	
12.50 p. m.		69.0	
2.50 p. m.		109.0	
3.50 p. m.		108.0	
4.50 p. m.		99.0	
5.50 p. m.		96.0	
6.50 p. m.		86.0	
7.00 p. m.	79.06		
7.50 p. m.		90.0	
8.50 p. m.		80.0	
10.00 p. m.		74.0	
10.50 p. m.		68.0	
Apr. 7, 7.00 a. m.	78.30	69.0	
Experiment No. 46.			
May 3, 7.00 a. m.	79.57	72.0	
9.50 a. m.		113.0	
10.50 a. m.		114.0	
11.50 a. m.		109.0	
12.50 p. m.		79.0	
2.50 p. m.		117.0	
3.50 p. m.		115.0	
4.50 p. m.		122.0	
5.50 p. m.		121.0	
6.50 p. m.		95.0	
7.00 p. m.	79.59		
8.50 p. m.		80.0	
10.50 p. m.		70.0	
May 4, 7.00 a. m.	79.13	64.0	
8.50 a. m.		117.0	
9.50 a. m.		111.0	
10.50 a. m.		114.0	
11.50 a. m.		106.0	
12.50 p. m.		70.0	
2.50 p. m.		119.0	
3.50 p. m.		110.0	
4.50 p. m.		105.0	
5.50 p. m.		120.0	
6.50 p. m.		87.0	
7.00 p. m.	79.52		
8.50 p. m.		81.0	
9.50 p. m.		76.0	
10.50 p. m.		67.0	
May 5, 7.00 a. m.	79.25	72.0	
8.50 a. m.		118.0	
9.50 a. m.		108.0	
10.50 a. m.		100.0	
11.50 a. m.		100.0	
1901.			
Experiment No. 46—Continued.	*Kilos.*		*°F.*
May 5, 12.50 p. m.		76.0	
2.50 p. m.		118.0	
3.50 p. m.		114.0	
4.50 p. m.		106.0	
5.50 p. m.		106.0	
6.50 p. m.		85.0	
7.00 p. m.	79.60		
7.50 p. m.		85.0	
8.50 p. m.		76.0	
9.50 p. m.		72.0	
10.50 p. m.		64.0	
May 6, 7.00 a. m.	79.32	70.0	
8.50 a. m.		114.0	
9.50 a. m.		104.0	
10.50 a. m.		101.0	
11.50 a. m.		100.0	
12.50 p. m.		72.0	
2.50 p. m.		110.0	
3.50 p. m.		104.0	
4.50 p. m.		96.0	
5.50 p. m.		94.0	
6.50 p. m.		85.0	
7.00 p. m.	79.71		
7.50 p. m.		87.0	
8.50 p. m.		77.0	
9.50 p. m.		72.0	
10.50 p. m.		60.0	
Experiment No. 47.			
May 7, 7.00 a. m.	79.29	62.0	
8.50 a. m.		119.0	
9.50 a. m.		116.0	
10.50 a. m.		114.0	
11.50 a. m.		103.0	
12.50 p. m.		70.0	
2.50 p. m.		114.0	
3.50 p. m.		106.0	
4.50 p. m.		103.0	
5.50 p. m.		98.0	
6.50 p. m.		82.0	
7.00 p. m.	79.70		
7.50 p. m.		83.0	
8.50 p. m.		77.0	
9.50 p. m.		76.0	
10.50 p. m.		61.0	
May 8, 7.00 a. m.	79.23	62.0	
8.50 a. m.		120.0	
9.50 a. m.		111.0	
10.50 a. m.		101.0	
11.50 a. m.		99.0	
12.50 p. m.		71.0	
2.50 p. m.		107.0	

TABLE 127.—*Body weight, pulse rate, and temperature, etc.*—Continued.

Time.	Weight in underclothes.	Pulse rate.	Temperature.
1901.			
Experiment No. 47—Continued.	*Kilos.*		°*F.*
May 8, 3.50 p. m.		106.0	
4.50 p. m.		97.0	
5.50 p. m.		97.0	
6.50 p. m.		84.0	
7.00 p. m.	79.63		
7.50 p. m.		85.0	
8.50 p. m.		79.0	
9.50 p. m.		74.0	
10.50 p. m.		59.0	
May 9, 7.00 a. m.	79.15	63.0	
8.50 a. m.		116.0	
9.50 a. m.		109.0	
10.50 a. m.		100.0	
11.50 a. m.		95.0	
12.50 p. m.		69.0	
2.50 p. m.		108.0	
3.50 p. m.		98.0	
4.50 p. m.		95.0	
5.50 p. m.		90.0	
6.50 p. m.		82.0	
7.00 p. m.	79.63		
7.50 p. m.		84.0	
8.50 p. m.		72.0	
9.50 p. m.		70.0	
10.50 p. m.		57.0	
May 10, 7.00 a. m.	79.13	64.0	
8.50 a. m.		117.0	
9.50 a. m.		107.0	
10.50 a. m.		101.0	
11.50 a. m.		99.0	
12.50 p. m.		69.0	
2.50 p. m.		109.0	
3.50 p. m.		105.0	
4.50 p. m.		103.0	
5.50 p. m.		107.0	
6.50 p. m.		80.0	
7.00 p. m.	79.48		
7.50 p. m.		87.0	
8.50 p. m.		80.0	
9.50 p. m.		77.0	
10.50 p. m.		59.0	
Experiment No. 48.			
May 11, 7.00 a. m.	79.06	63.0	
8.50 a. m.		110.0	
9.50 a. m.		97.0	
10.50 a. m.		97.0	
11.50 a. m.		94.0	
12.50 p. m.		72.0	
2.50 p. m.		108.0	
3.50 p. m.		106.0	
4.50 p. m.		98.0	

Time.	Weight in underclothes.	Pulse rate.	Temperature.
1901.			
Experiment No. 48—Continued.	*Kilos.*		°*F.*
May 11, 5.50 p. m.		90.0	
6.50 p. m.		81.0	
7.00 p. m.	79.49		
7.50 p. m.		87.0	
8.50 p. m.		77.0	
9.50 p. m.		74.0	
10.50 p. m.		57.0	
May 12, 7.00 a. m.	78.82	71.0	
1902.			
Experiment No. 49.			
Mar. 27, 6.50 a. m.		75.0	97.6
7.00 a. m.	80.35		
12.50 p. m.		69.0	98.1
6.50 p. m.		88.0	98.4
7.00 p. m.	80.71		
10.00 p. m.		77.0	98.3
Mar. 28, 6.50 a. m.		75.0	97.3
7.00 a. m.	80.42		
12.50 p. m.		68.0	96.9
6.50 p. m.		81.0	98.1
7.00 p. m.	81.12		
10.00 p. m.		68.0	97.8
Mar. 29, 6.50 a. m.		69.0	97.8
7.00 a. m.	80.82		
12.50 p. m.		65.0	97.6
6.50 p. m.		82.0	98.9
7.00 p. m.	81.12		
10.00 p. m.		74.0	98.3
Mar. 30, 6.50 a. m.		74.0	97.7
Experiment No. 50.			
Mar. 30, 7.00 a. m.	80.70		
12.50 p. m.		75.0	97.2
6.00 p. m.		67.0	98.3
7.00 p. m.	80.51		
10.00 p. m.		55.0	97.7
Experiment No. 51.			
Mar. 31, 7.00 a. m.	79.78	77.0	97.5
1.00 p. m.		69.0	98.2
7.00 p. m.		65.0	97.9
10.50 p. m.		74.0	97.1
Apr. 1, 7.00 a. m.	78.31	70.0	97.3
12.50 p. m.		68.0	98.5
6.50 p. m.		64.0	98.5
10.50 p. m.		63.0	97.1
Apr. 2, 7.00 a. m.	77.89	76.0	97.0
Experiment No. 52.			
Apr. 21, 6.50 a. m.		73.0	97.8
7.00 a. m.	79.77		
8.20 a. m.		110.0	

TABLE 127.—*Body weight, pulse rate, and temperature, etc.*—Continued.

Time.	Weight in underclothes.	Pulse rate.	Temperature.	Time.	Weight in underclothes.	Pulse rate.	Temperature.
1902.				1902.			
Experiment No. 52—Continued.	*Kilos.*		°*F.*	*Experiment No. 52*—Continued.	*Kilos.*		°*F.*
Apr. 21, 8.30 a. m.	....	111.0	....	Apr. 22, 9.20 a. m.	....	108.0	....
8.40 a. m.	....	113.0	....	9.30 a. m.	....	109.0	....
8.50 a. m.	....	111.0	....	9.40 a. m.	....	108.0	....
9.10 a. m.	....	106.0	....	10.00 a. m.	....	106.0	....
9.20 a. m.	....	108.0	....	10.10 a. m.	....	106.0	....
9.30 a. m.	....	106.0	....	10.40 a. m.	....	102.0	....
9.40 a. m.	....	104.0	....	10.50 a. m.	....	104.0	....
9.50 a. m.	....	103.0	....	11.10 a. m.	....	101.0	....
10.00 a. m.	....	103.0	....	11.20 a. m.	....	103.0	....
10.10 a. m.	....	102.0	....	11.30 a. m.	....	99.0	....
10.40 a. m.	....	110.0	....	11.40 a. m.	....	101.0	....
10.50 a. m.	....	112.0	....	11.50 a. m.	....	97.0	....
11.10 a. m.	....	108.0	....	12.00 m	....	100.0	....
11.20 a. m.	....	109.0	....	12.10 p. m.	....	101.0	....
11.30 a. m.	....	105.0	....	12.20 p. m.	....	99.0	....
11.40 a. m.	....	105.0	....	12.50 p. m.	....	76.0	97.95
11.50 a. m.	....	101.0	....	2.00 p. m.	....	114.0	....
12.00 m	....	105.0	....	2.20 p. m.	....	116.0	....
12.10 p. m.	....	103.0	....	2.30 p. m.	....	110.0	....
12.20 p. m.	....	104.0	....	2.40 p. m.	....	109.0	....
12.50 p. m.	....	77.0	98.4	2.50 p. m.	....	108.0	....
2.10 p. m.	....	122.0	....	3.10 p. m.	....	109.0	....
2.20 p. m.	....	116.0	....	3.20 p. m.	....	106.0	....
2.30 p. m.	....	119.0	....	3.30 p. m.	....	110.0	....
2.40 p. m.	....	123.0	....	3.40 p. m.	....	108.0	....
2.50 p. m.	....	118.0	....	3.50 p. m.	....	107.0	....
3.10 p. m.	....	116.0	....	4.20 p. m.	....	108.0	....
3.20 p. m.	....	118.0	....	4.30 p. m.	....	107.0	....
3.30 p. m.	....	122.0	....	4.40 p. m.	....	106.0	....
3.40 p. m.	....	121.0	....	4.50 p. m.	....	107.0	....
3.50 p. m.	....	121.0	....	5.10 p. m.	....	108.0	....
4.20 p. m.	....	118.0	....	5.20 p. m.	....	107.0	....
4.30 p. m.	....	122.0	....	5.30 p. m.	....	110.0	....
4.40 p. m.	....	122.0	....	5.40 p. m.	....	105.0	....
4.50 p. m.	....	121.0	....	5.50 p. m.	....	106.0	....
5.10 p. m.	....	120.0	....	6.00 p. m.	....	102.0	....
5.20 p. m.	....	122.0	....	6.10 p. m.	....	104.0	....
5.30 p. m.	....	124.0	....	6.50 p. m.	....	85.0	98.1
5.40 p. m.	....	125.0	....	7.00 p. m.	80.12	....	....
5.50 p. m.	....	122.0	....	10.00 p. m.	....	72.0	97.7
6.00 p. m.	....	123.0	....	Apr. 23, 6.00 a. m.	....	70.0	97.6
6.10 p. m.	....	124.0	....	7.00 a. m.	79.48	....	....
6.50 p. m.	....	101.0	98.8	8.20 a. m.	....	117.0	....
7.00 p. m.	79.94	....	....	8.30 a. m.	....	117.0	....
10.00 p. m.	....	78.0	98.1	8.40 a. m.	....	116.0	....
Apr. 22, 6.50 a. m.	....	74.0	97.7	8.50 a. m.	....	111.0	....
7.00 a. m.	79.15	....	....	9.10 a. m.	....	109.0	....
8.20 a. m.	....	115.0	....	9.20 a. m.	....	108.0	....
8.30 a. m.	....	114.0	....	9.30 a. m.	....	109.0	....
8.40 a. m.	....	115.0	....	9.40 a. m.	....	104.0	....
8.50 a. m.	....	114.0	....	9.50 a. m.	....	105.0	....
9.10 a. m.	....	109.0	....	10.00 a. m.	....	107.0	....

TABLE 127.—*Body weight, pulse rate, and temperature, etc.*—Continued.

Time.	Weight in underclothes.	Pulse rate.	Temperature.
1902.			
Experiment No. 52—Continued.	*Kilos.*		*°F.*
Apr. 23, 10.10 a. m.		106.0	
10.40 a. m.		104.0	
10.50 a. m.		104.0	
11.10 a. m.		104.0	
11.20 a. m.		101.0	
11.30 a. m.		101.0	
11.40 a. m.		101.0	
11.50 a. m.		102.0	
12.00 m		97.0	
12.10 p. m.		101.0	
12.20 p. m.		100.0	
12.50 p. m.		70.0	97.6
2.10 p. m.		113.0	
2.20 p. m.		116.0	
2.30 p. m.		111.0	
2.40 p. m.		111.0	
2.50 p. m.		112.0	
3.10 p. m.		110.0	
3.20 p. m.		109.0	
3.30 p. m.		110.0	
3.40 p. m.		108.0	
3.50 p. m.		109.0	
4.20 p. m.		108.0	
4.30 p. m.		108.0	
4.40 p. m.		108.0	
4.50 p. m.		108.0	
5.10 p. m.		104.0	
5.20 p. m.		109.0	
5.40 p. m.		106.0	
5.50 p. m.		107.0	
6.00 p. m.		105.0	
6.10 p. m.		107.0	
6.50 p. m.		84.0	98.2
7.00 p. m.	80.23		
10.00 p. m.		71.0	97.95
Apr. 24, 6.50 a. m.		70.0	97.6
Experiment No. 53.			
Apr. 24, 7.00 a. m.	79.44		
8.20 a. m.		117.0	
8.30 a. m.		121.0	
8.40 a. m.		120.0	
8.50 a. m.		117.0	
9.10 a. m.		109.0	
9.20 a. m.		110.0	
9.30 a. m.		110.0	
9.40 a. m.		112.0	
9.50 a. m.		110.0	
10.00 a. m.		107.0	
10.10 a. m.		106.0	
10.40 a. m.		106.0	
10.50 a. m.		110.0	

Time.	Weight in underclothes.	Pulse rate.	Temperature.
1902.			
Experiment No. 53—Continued.	*Kilos.*		*°F.*
Apr. 24, 11.10 a. m.		107.0	
11.20 a. m.		106.0	
11.30 a. m.		103.0	
11.40 a. m.		105.0	
11.50 a. m.		100.0	
12.00 m		102.0	
12.10 p. m.		103.0	
12.20 p. m.		103.0	
12.50 p. m.		73.0	97.9
2.10 p. m.		107.0	
2.20 p. m.		107.0	
2.30 p. m.		107.0	
2.40 p. m.		106.0	
2.50 p. m.		108.0	
3.10 p. m.		107.0	
3.20 p. m.		102.0	
3.30 p. m.		107.0	
3.40 p. m.		106.0	
3.50 p. m.		103.0	
4.20 p. m.		105.0	
4.30 p. m.		100.0	
4.40 p. m.		100.0	
4.50 p. m.		103.0	
5.10 p. m.		103.0	
5.20 p. m.		101.0	
5.30 p. m.		101.0	
5.40 p. m.		103.0	
5.50 p. m.		103.0	
6.00 p. m.		99.0	
6.10 p. m.		98.0	
6.50 p. m.		79.0	97.4
7.00 p. m.	80.63		
10.00 p. m.		74.0	98.2
Apr. 25, 6.50 a. m.		69.0	98.0
7.00 a. m.	80.11		
8.20 a. m.		115.0	
8.30 a. m.		116.0	
8.40 a. m.		122.0	
8.50 a. m.		116.0	
9.10 a. m.		115.0	
9.20 a. m.		113.0	
9.30 a. m.		112.0	
9.40 a. m.		110.0	
9.50 a. m.		109.0	
10.00 a. m.		112.0	
10.10 a. m.		111.0	
10.40 a. m.		110.0	
10.50 a. m.		112.0	
11.10 a. m.		103.0	
11.20 a. m.		106.0	
11.30 a. m.		102.0	
11.40 a. m.		104.0	

TABLE 127.—*Body weight, pulse rate, and temperature, etc.*—Continued.

Time.	Weight in underclothes.	Pulse rate.	Temperature.	Time.	Weight in underclothes.	Pulse rate.	Temperature.
1902.				1902.			
Experiment No. 53—Continued.	*Kilos.*		°*F.*	*Experiment No. 53*—Continued.	*Kilos.*		°*F.*
Apr. 25, 11.50 a. m.	....	102.0	....	Apr. 26, 12.20 p. m.	....	100.0	....
12.00 m.	....	107.0	....	12.50 p. m.	....	72.0	98.0
12.10 p. m.	....	106.0	....	2.10 p. m.	....	116.0	....
12.20 p. m.	....	103.0	....	2.20 p. m.	....	116.0	....
12.50 p. m.	....	70.0	98.1	2.30 p. m.	....	117.0	....
2.10 p. m.	....	111.0	....	2.40 p. m.	....	114.0	....
2.20 p. m.	....	115.0	....	2.50 p. m.	....	116.0	....
2.30 p. m.	....	122.0	....	3.10 p. m.	....	108.0	....
2.40 p. m.	....	117.0	....	3.20 p. m.	....	107.0	....
2.50 p. m.	....	114.0	....	3.30 p. m.	....	112.0	....
3.10 p. m.	....	112.0	....	3.40 p. m.	....	110.0	....
3.20 p. m.	....	112.0	....	3.50 p. m.	....	110.0	....
3.30 p. m.	....	111.0	....	4.20 p. m.	....	108.0	....
3.50 p. m.	....	112.0	....	4.30 p. m.	....	110.0	....
4.20 p. m.	....	107.0	....	4.40 p. m.	....	110.0	....
4.30 p. m.	....	109.0	....	4.50 p. m.	....	106.0	....
4.40 p. m.	....	109.0	....	5.10 p. m.	....	100.0	....
4.50 p. m.	....	109.0	....	5.20 p. m.	....	102.0	....
5.10 p. m.	....	105.0	....	5.30 p. m.	....	97.0	....
5.20 p. m.	....	106.0	....	5.40 p. m.	....	96.0	....
5.30 p. m.	....	102.0	....	5.50 p. m.	....	95.0	....
5.40 p. m.	....	103.0	....	6.00 p. m.	....	96.0	....
5.50 p. m.	....	105.0	....	6.10 p. m.	....	92.0	....
6.00 p. m.	....	96.0	....	6.50 p. m.	....	79.0	98.5
6.10 p. m.	....	91.0	....	7.00 p. m.	80.89	....	....
6.50 p. m.	....	81.0	98.4	10.00 p. m.	....	73.0	98.2
7.00 p. m.	80.73	....	....	Apr. 27, 6.50 a. m.	....	62.0	97.2
10.00 p. m.	....	73.0	98.1				
Apr. 26, 6.50 a. m.	....	69.0	97.3	*Experiment No. 54.*			
7.00 a. m.	80.36	....	....	Apr. 27, 7.00 a. m.	80.22	....	....
8.20 a. m.	....	115.0	....	8.20 a. m.	....	118.0	....
8.30 a. m.	....	116.0	....	8.30 a. m.	....	122.0	....
8.40 a. m.	....	118.0	....	8.40 a. m.	....	124.0	....
8.50 a. m.	....	118.0	....	8.50 a. m.	....	121.0	....
9.10 a. m.	....	116.0	....	9.10 a. m.	....	116.0	....
9.20 a. m.	....	116.0	....	9.20 a. m.	....	117.0	....
9.30 a. m.	....	112.0	....	9.30 a. m.	....	110.0	....
9.40 a. m.	....	112.0	....	9.40 a. m.	....	104.0	....
9.50 a. m.	....	110.0	....	9.50 a. m.	....	105.0	....
10.00 a. m.	....	111.0	....	10.00 a. m.	....	105.0	....
10.10 a. m.	....	110.0	....	10.10 a. m.	....	103.0	....
10.40 a. m.	....	107.0	....	10.40 a. m.	....	100.0	....
10.50 a. m.	....	107.0	....	10.50 a. m.	....	98.0	....
11.10 a. m.	....	100.0	....	11.10 a. m.	....	97.0	....
11.20 a. m.	....	103.0	....	11.20 a. m.	....	97.0	....
11.30 a. m.	....	103.0	....	11.30 a. m.	....	95.0	....
11.40 a. m.	....	101.0	....	11.40 a. m.	....	96.0	....
11.50 a. m.	....	101.0	....	11.50 a. m.	....	95.0	....
12.00 m.	....	99.0	....	12.00 m.	....	98.0	....
12.10 p. m.	....	101.0	....	12.10 p. m.	....	97.0	....

TABLE 127.—*Body weight pulse, rate, and temperature, etc.*—Continued.

Time.	Weight in underclothes.	Pulse rate.	Temperature.	Time.	Weight in underclothes.	Pulse rate.	Temperature.
1902.				1902.			
Experiment No. 54—Continued.	*Kilos.*		*°F.*	*Experiment No. 54*—Continued.	*Kilos.*		*°F.*
Apr. 27, 12.20 p. m.	....	99.0	....	Apr. 28, 2.30 p. m.	....	112.0	....
12.50 p. m.	....	73.0	98.4	2.40 p. m.	....	112.0	....
2.10 p. m.	....	114.0	....	2.50 p. m.	....	111.0	....
2.20 p. m.	....	113.0	....	3.10 p. m.	....	113.0	....
2.30 p. m.	....	113.0	....	3.20 p. m.	....	111.0	....
2.40 p. m.	....	112.0	....	3.30 p. m.	....	118.0	....
2.50 p. m.	....	106.0	....	3.40 p. m.	....	120.0	....
3.10 p. m.	....	109.0	....	3.50 p. m.	....	115.0	....
3.20 p. m.	....	114.0	....	4.20 p. m.	....	111.0	....
3.30 p. m.	....	110.0	....	4.30 p. m.	....	114.0	....
3.40 p. m.	....	110.0	....	4.40 p. m.	....	112.0	....
3.50 p. m.	....	108.0	....	4.50 p. m.	....	112.0	....
4.20 p. m.	....	102.0	....	5.10 p. m.	....	118.0	....
4.30 p. m.	....	105.0	....	5.20 p. m.	....	114.0	....
4.40 p. m.	....	104.0	....	5.30 p. m.	....	110.0	....
4.50 p. m.	....	102.0	....	5.40 p. m.	....	103.0	....
5.10 p. m.	....	102.0	....	6.50 p. m.	....	83.0	98.6
5.20 p. m.	....	102.0	....	7.00 p. m.	80.21	....	....
5.30 p. m.	....	104.0	....	10.00 p. m.	....	73.0	97.3
5.40 p. m.	....	101.0	....	Apr. 29, 6.50 a. m.	....	67.0	97.3
5.50 p. m.	....	105.0	....	7.00 a. m.	79.41	....	....
6.00 p. m.	....	104.0	....	8.20 a. m.	....	110.0	....
6.10 p. m.	....	105.0	....	8.30 a. m.	....	124.0	....
6.50 p. m.	....	86.0	97.1	8.40 a. m.	....	122.0	....
7.00 p. m.	80.45	....	....	8.50 a. m.	....	119.0	....
10.00 p. m.	....	77.0	97.7	9.10 a. m.	....	119.0	....
Apr. 28, 6.50 a. m.	....	73.0	97.5	9.20 a. m.	....	114.0	....
7.00 a. m.	79.73	....	....	9.30 a. m.	....	117.0	....
8.20 a. m.	....	124.0	....	9.50 a. m.	....	115.0	....
8.30 a. m.	....	126.0	....	10.00 a. m.	....	114.0	....
8.40 a. m.	....	122.0	....	10.10 a. m.	....	112.0	....
8.50 a. m.	....	120.0	....	10.40 a. m.	....	113.0	....
9.10 a. m.	....	117.0	....	10.50 a. m.	....	108.0	....
9.20 a. m.	....	116.0	....	11.10 a. m.	....	110.0	....
9.30 a. m.	....	114.0	....	11.20 a. m.	....	112.0	....
9.40 a. m.	....	110.0	....	11.30 a. m.	....	106.0	....
9.50 a. m.	....	109.0	....	11.40 a. m.	....	105.0	....
10.00 a. m.	....	108.0	....	11.50 a. m.	....	103.0	....
10.10 a. m.	....	107.0	....	12.00 m.	....	103.0	....
10.40 a. m.	....	104.0	....	12.10 p. m.	....	105.0	....
10.50 a. m.	....	105.0	....	12.20 p. m.	....	107.0	....
11.10 a. m.	....	105.0	....	12.50 p. m.	....	73.0	97.7
11.20 a. m.	....	105.0	....	2.10 p. m.	....	121.0	....
11.30 a. m.	....	101.0	....	2.20 p. m.	....	118.0	....
11.40 a. m.	....	103.0	....	2.30 p. m.	....	112.0	....
11.50 a. m.	....	105.0	....	2.40 p. m.	....	110.0	....
12.00 m.	....	106.0	....	2.50 p. m.	....	111.0	....
12.10 p. m.	....	107.0	....	3.10 p. m.	....	107.0	....
12.20 p. m.	....	107.0	....	3.20 p. m.	....	109.0	....
12.50 p. m.	....	73.0	98.3	3.30 p. m.	....	109.0	....
2.20 p. m.	....	111.0	....	3.40 p. m.	....	110.0	....

TABLE 127.—*Body weight, pulse rate, and temperature, etc.*—Continued.

Time.	Weight in underclothes.	Pulse rate.	Temperature.	Time.	Weight in underclothes.	Pulse rate.	Temperature.
1902.				1902.			
Experiment No. 54—Continued.	*Kilos.*		*°F.*	*Experiment No. 54*—Continued.	*Kilos.*		*°F.*
Apr. 29, 3.50 p. m....	....	111.0	....	Apr. 29, 6.10 p. m....	....	106.0	....
4.20 p. m....	....	102.0	....	6.50 p. m....	....	87.0	98.4
4.30 p. m....	....	106.0	....	7.00 p. m....	80.11	....	....
4.40 p. m....	....	104.0	....	10.00 p. m...	....	75.0	98.0
4.50 p. m....	....	101.0	....	Apr. 30, 6.50 a. m....	....	80.0	97.7
5.10 p. m....	....	101.0	....				
5.20 p. m....	....	107.0	....	*Experiment No. 55.*			
5.30 p. m....	....	105.0	....	Apr. 30, 7.00 a. m....	79.15	....	....
5.40 p. m....	....	109.0	....	6.50 p. m....	....	98.0	98.6
5.50 p. m....	....	104.0	....	7.00 p. m....	78.81	....	....
6.00 p. m....	....	106.0	....	May 1, 7.00 a. m....	76.42	....	....

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